Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY McGRAW PUBLISHING COMPANY, INC.

Volume 71 NEW YORK, SATURDAY, APRIL 10, 1915 Number 15

Limiting Train Lengths

RAILROAD managers are viewing with apprehension the growing agitation of trainmen's organizations for legislation limiting the lengths of trains. Pernicious as "extra-crew" laws are, laws to shorten trains would be far worse; while the former only put an unnecessary man on each train, the latter would put on entire crews. If such restrictions become prevalent it will mean that money spent in grade reductions and in more powerful locomotives has virtually been thrown away. The regulators have been clamoring for greater railroad efficiency, and one of the most scientific and productive agencies for increased efficiency is the use of larger operating units—larger cars and longer trains. Indeed, it is asserted that some of the newer lines would never have been built except on the basis of light grades, heavy engines and long trains. If the public will not interest itself in the saving of the railroad's money, however, the question of safety may strike nearer home. Doubling the number of trains on a single-track railroad quadruples the number of meetings of trains, while even on double track lines the chances for error in judgment and disobedience are doubled. Moreover, it is obviously easier to provide one efficient crew than two. There are plain indications that the full-crew law has about run its course and that the public is coming to recognize it for what it is, a bald attempt, hiding behind a false front of increased safety, to create unnecessary and undesirable employment at railroad and public expense. It is to be hoped that the more sinister movement for doing the same thing on a larger scale, by limiting train lengths, will be nipped in the bud.

Engineers and Military Training

ATTENTION has been called in this journal to the committee appointed by the Western Society of Engineers to consider ways and means of bringing about such organization as would allow the country, in case of war, to make effective use of the services of engineers. Several other societies have been in touch with the War Department on this matter, but it now appears that little can be done until enabling legislation is passed which will provide funds for carrying on whatever work seems advisable. Two years ago the entire subject of the perfection of the military reserve was reported on, but Secretary Garrison has asked that the matter be restudied so that the necessary legislation may be framed. It was discovered that no funds are available for defraying the expense of any scheme of co-operation between the War Department and societies or for enabling the department to keep in touch effectively with prospective reserves. Moreover, there did not seem to be funds available even for sending to Chicago an officer who might confer with the officials of the Western Society as to the program which they might follow. Apparently, therefore, little will be done along these lines until Congress makes the necessary appropriation. However, those members of the Western Society of Engineers interested propose to meet on occasion for the study of military engineering and to inaugurate lectures and discussions, supplemented by individual effort. This idea can be carried out by any technical organization and under existing conditions it is about all that the civilian can do unless he joins the regulars or the Engineer Corps of the State militia. It is conceivable that many men who are unwilling to engage in the drill required of members of the militia would nevertheless be willing to acquire some knowledge of military engineering. Certainly the Government would be the eventual gainer by making it possible to give the instruction to such men.

Engineers and Campaign Collections

IT is still a long way from election day but an item in the week's news suggests the desirability of calling attention to a practice which is all too prevalent in the fall of the year. The Appellate Division of a State Supreme Court has recently affirmed the dismissal of the chief engineer of the sewer department of a large Eastern city on the ground that he had used his position to collect campaign contributions from the men under him in the department. No man with any regard for the ethics of his profession, or in short of any ethics, would stoop to such measures to intrench himself in the good graces of those in power. The duties of the chief engineer of a sewer department include the supervision over the design and construction of sewers and stop there. When an executive descends to the practice of making of himself a runner for a political ring he disgraces the title of civil engineer. If the damage done were confined only to the chief engineer himself the result would be deplorable enough, but by calling upon his subordinates to "chip in" for the support of a political candidate the engineering executive destroys, at a single stroke, the morale of his entire department and creates, especially in the minds of the younger members of his staff, a distorted picture of the engineer's place in the affairs of the city. There is under way throughout the country a concerted movement to place the engineer before the public in the proper light. Such incidents as the one cited, although they are by no means representative, are serious obstacles in the securing of proper recognition for the technical man.

The Critical 1 Per Cent

THE letter by R. D. Johnson on page 467 of this issue sets forth a situation that will probably cause surprise to many readers of the Engineering Record. Immense hydroelectric plants have followed one another so rapidly in recent years that it seemed fair to infer that every last refinement was being employed to capture every available fraction of power, particularly since hydroelectric investments have not been uniformly profitable and the possible additional 1 per cent might be critical—marking the success or failure of the enterprise. Undoubtedly the engineering of the great plants constructed in recent years has been characterized by most painstaking consideration of all of the factors influencing the hydraulic efficiency of the plants, but, as Mr. Johnson says, the whole spirit of hydraulic design has not been so keen for the small increments of efficiency as has the design of electrical machinery. The statement needs qualification, however, for certainly the turbine builders have watched each tenth of a per cent in rise of their efficiency curves. In the older plants—and in this category may be included practically all of those built previous to the year 1907—the marks of youth, in a designing sense, are plainly visible, and in these undoubtedly the slight changes to which Mr. Johnson refers would result in a considerable increase in earning capacity. The same may be said of later plants of average size. This, however, was inevitable in the early development of an art and while it may seem strange to speak of designs made ten years ago as being part of the early development of hydroelectric design the statement can stand when the very rapid progress of the last decade is taken into consideration. Without a doubt the attitude which Mr. Johnson discusses is rapidly disappearing and his comparison between the efficiency of electrical and hydraulic designs should serve to impress upon hydraulic engineers the need for taking a most serious view of the possible decrease in efficiency resultant upon errors in the small details.

New Type of Filter

TIME alone will tell whether Toronto has acted wisely in adopting for the enlargement of its facilities for water purification a comparatively new type of apparatus operating upon a principle radically different from anything which has seen service in this country. The results secured at a test plant with a capacity of 500,000 imp. gal. daily, described on page

464, have convinced the officials of the Department of Public Health that the selection of the "drifting-sand" type of rapid filter for the new 60,000,000 imp. gal. per day installation is justified. Whatever may be said of the drifting-sand filter, it is certainly an ingenious device. The feature which makes it different from the common type of mechanical filter is that the dirty sand is removed, washed and replaced without interrupting the continuous operation of the unit, except at comparatively long intervals. Of course, the same result, continuity of service, is accomplished by the Blaisdell sand-washing machine for filters of the slow-sand type, but the two processes have nothing else in common. In the drifting-sand filter the sand assumes the shape of a cone from the base of which the dirty grains are constantly being removed by an extractor which delivers to a sand-washer. The washed sand is discharged into the rapidly moving column of raw water and is thus carried into the top of the filter and deposited upon the apex of the cone from which it falls down along the sides, completing the cycle. A core of sand at the center of the cone remains constantly in place, its volume depending upon the angle of repose of the sand. During the Toronto tests the entire filter was back-washed at intervals of about 8 days. While the test run appears to have given results satisfactory to the Toronto officials final judgment on the merits of the process must be withheld until the city's large plant has been placed in operation. It is safe to say, however, that when water is actually being purified on a large scale by the drifting-sand method Toronto will be the Mecca of waterworks men who wish to keep abreast of the latest developments in the art.

Misusing Brick

ELSEWHERE in this issue will be found an account of the Florida practice in the construction of brick roads—a practice temporarily redounding to the advantage of the brick manufacturers but destined in the end to handicap the use of this material. The roads are only 9 ft. wide and brick are laid on a sand foundation with a sand filler. This is another instance of the unintelligent commercial campaigning which has been characteristic of the highway field. Temporary advantage has commonly been the controlling motive of these campaigns, unlike the policy of large manufacturing corporations which, of late, have taken the stand that a purchaser could not buy their equipment or material unless it was suited to his purposes. Of course there are now manufacturers of road building materials who take the same position, and it is possible that companies may be found which have always guided their sales policies by fundamentally sound economic considerations. As a generalization, however, the indictment above expressed holds. Of the value of brick as a road-building material there is no doubt. Likewise there is no doubt that its misuse, as is the current practice in Florida, will lead to unsatisfactory results and the unfortunate condemnation of a product which is deserving of a better judgment. The lesson of the Florida situation is that engineers need to come into a larger influence in the highway affairs of the State. With a strong highway commission setting the standards and a survey of the State to locate what local road-building materials there may be, the people should be assured of a better expenditure of their moneys and the State of a wider development. Instead of spending money foolishly on highways that need to be rebuilt in three or four years, and of a type by its nature expensive, a much larger mileage of a cheaper but adequate surfacing will be provided. Mr. Foote, the author of the article in question, is firmly convinced that brick has no place at present on Florida's roads. His statement is based upon familiarity with Florida conditions and those not cognizant of the situation can at least take the stand that if the brick is to be used it should be employed on sound engineering lines, with a concrete foundation and a cement filler.

San Francisco's Vote Will Decide the Spring Valley Purchase

SAN FRANCISCO faces a crisis in the question of how to secure and insure an adequate water supply pending the completion of the Hetch Hetchy project. When the Raker bill was finally passed by Congress it was generally thought that the final solution of the water problem had been reached in the sanction of a supply from the Hetch Hetchy Valley. It has developed, however, that there are reasons why it is not feasible to rush the Hetch Hetchy project to completion, and during the period of years that must elapse before water can be brought to the city from the Sierras some adequate temporary source must be drawn upon if the growth of the residential districts is not to be restricted.

Relief cannot be expected from the Spring Valley Water Company, which is now supplying the city, because there is no inducement for further investment in its system until the present situation is cleared up. Meanwhile the city is powerless to compel the company to make the extensions desired. About two years ago the city decided to acquire the properties of the Spring Valley company by condemnation. The most important development in the proceedings to date has been the certainty that the case would be so deeply involved that a settlement could not be expected for a long time. Before a final decision could be reached the city would be subject to serious water shortage. Since deciding to enter the condemnation suit the city has spent $100,000 in making inventories and appraisals of those portions of the properties considered necessary and sufficient for the city's use, and has arrived at an accurate estimate of the value of the properties required. Recent negotiations with the company have elicited the offer to sell these properties to the city for $34,500,000, thereby avoiding the delay and expense of a condemnation suit with its uncertain outcome. The Board of Supervisors has submitted the proposition to popular vote, which will be cast on April 20.

The facts of the case are that the city cannot economically complete the Hetch Hetchy system for a number of years, and meantime improvements and extensions in the present water supply system are very urgently needed. The private company, naturally, will not make these improvements while a condemnation suit against its entire property is in progress. To take care of its needs the city, therefore, has the choice of developing some temporary source and laying its own distribution system, with the great expense and inconvenience to traffic involved, or settling the condemnation suit out of court. It is true that the distribution system of the private company is not now just what the city needs, but it is valued, in the purchase price being considered, at only one-tenth the total figure. On the other hand the sources which are now supplying 40,000,000 gal. daily to the city could be improved in nine months at a cost of $4,000,000 so as to supply 60,000,000 gal. daily, and neither the original purchase of the properties nor these improvements would increase the present tax rate, it is pointed out, because the receipts from water sales now exceed interest on $34,500,000 at 4½ per cent, plus an annual depreciation of $250,000 as well as maintenance and other charges.

The private company owns seven reservoirs on the best sites within the city for effectively maintaining the desired pressures at the various city levels, which cannot be duplicated. Also there are several large storage reservoirs on the peninsula which are highly desirable reserve units because of the long conduit from the Hetch Hetchy valley. In short, except for parts of the distribution system, which are valued low accordingly, all the properties it is proposed to purchase would be useful auxiliaries of the Hetch Hetchy system when finally completed.

Arrayed on opposite sides in this issue are those who believe that the purchase of the Spring Valley system by the municipality is necessary to the proper growth of the city, and those who see in every move favoring such purchase the veiled influence of a corporation desiring to sell out for more than its holdings are worth. Naturally the latter argument is one with which a powerful appeal to the masses can be made and with strong opposition to the purchase there is danger that many who have a voice in deciding the matter may be prejudiced against the acquisition of the water system.

The Engineering Record believes that public ownership of a water supply system is the only way to permanently insure adequate service to the modern large American city. Setting aside local and partisan views it seems perfectly clear that the right course to pursue in San Francisco is to acquire the Spring Valley system in the quickest way possible. The question of price is a very important one, but studies have been made for both sides by leading engineering experts of the United States.

M. M. O'Shaughnessy, city engineer of San Francisco, under whose supervision the appraisal for the city was made, states that the price under consideration is fair.

The issue which San Francisco will face on April 20 is one which vitally concerns the future prosperity of the city. It involves a question of economics which every other large city of the United States, with one exception, has already decided in the affirmative. To the Engineering Record it seems that the purchase of the Spring Valley system by the city of San Francisco is the most satisfactory solution of the problem.

Co-operation versus Inspection Tyranny on Contract Work

COMMENTING recently on an editorial in this journal on the mistakes and opportunities of the college man in construction work, one contractor remarked that on a small bridge contract a recent graduate, acting as inspector for the State, had cost him, without any advantage to the State, $15,000, while another stated that the "school-boy inspector" was the curse of public works contracts. The remarks are not novel; everyone familiar with construction work has heard similar ones before, or, on account of bitter experience, has been impelled to make them himself. The occasion, however, warrants some observations on the proper qualifications of inspectors.

As a first principle it should be laid down that the number of inspectors having authority to interpret and enforce specifications on any job should be limited to one, or, at most, to one for each main division of the work. Such men should be carefully selected and much better paid than is now the case. They should bring to their work large and detailed experience on construction, thorough acquaintance with the types of men with whom they must deal, and proved ability in handling such men and in gaining their points without quarrels and delays. Further, such inspectors must have the vision, now almost universally lacking, to see that they are employed to serve the best interests of the work, and not to "sting" the contractor.

To do their work satisfactorily they must spend their entire time on the job, mixing with the foremen, giving the job the benefit of their experience, helping educate the contractor and his force to what constitutes good work, showing why it is to the contractor's advantage to do good work, and how such work can be done efficiently. No office detail, instrument work, or other interruption should be permitted to interfere with their duties. They should be in supreme charge, under the resident engineer, of the important task of uniting all hands to produce a satisfactory result.

One such man can win the confidence and co-operation of a contractor's force so fully that better results will be secured than with a dozen of the "school-boy" inspectors now so common on public works. The construction force comes to know that when it is doing its best to push the job ahead by proper and efficient means no one will stop it for some foolish detail, questioned usually through ignorance on the part of the challenger. Consequently, co-operation replaces strife, and the intelligent workmen of the contractor become assistants rather than enemies of the inspector. Many resident engineers have, it is true, followed this practice either through their own initiative, or because of the inspiration of an intelligent chief engineer. In such cases it will be found that this fair treatment is an excellent solution of most inspection troubles.

It is manifestly unfair to clothe with authority to interfere with a contractor's operations a man who has had no experience in handling men or work, as is now too often done. It is evident that through his ignorance trifles will assume undue importance, and matter of moment be neglected. The inevitable result is to undermine his standing with the contractor and to reduce his authority to that which can be enforced only through constant petty squabbles.

Recently a representative of this journal had occasion to observe conditions on Government work where a large force of inspectors was employed, practically one for each gang engaged in placing permanent work. Much of the time these inspectors could not be kept busy with their particular duties, and consequently from their ranks were drawn the surveying crew and the clerical and drafting forces. The men were constantly changing duties, with the result that each felt qualified to "butt in" on any work that did not suit him, whether he was supposed to be inspecting it at the time or not. Endless confusion and dissatisfaction and several lively personal feuds were directly traceable to this practice.

Such experiences emphasize the necessity of a responsible, intelligent, and, of necessity, properly paid head, who shall be in direct hourly contact with the contractor's forces throughout the job, if the present inspection problems are to be solved with justice to the contractor and the ultimate advantage of those who pay for engineering works.

Shortage of Labor in England

IT is entirely obvious that when a considerable proportion of the able bodied men in any country are withdrawn from their ordinary occupations for military service, manufactures are of necessity seriously handicapped by lack of men. At the beginning of the present war the loss of efficient labor fell most heavily on those countries having compulsory service and England, depending on the volunteer system and not having a great army in the field, got off rather lightly. In fact the English manufacturers were at first disposed rather to scoff at the idea that production would be crippled to any serious extent by the war. So far as can be ascertained from the publications of the English technical press, however, that advantage is now in a large measure lost and it is becoming increasingly difficult to supply the labor for replacing volunteers and to keep up, with this shortened supply, the output of products vitally needed in the national crisis. Only within a few days announcement was made that the English Government was arranging to take over certain works for the supply of war material so as to obtain the needed output. Complaints are increasing in number and seriousness that the British labor unions have not risen to their full duty in the matter of holding up the hands of the Government in its desperate struggle.

Great Britain has been unionized to an exceptionally great extent, particularly as regards the regulation of the hours of labor, and despite appeals from both civil and military authorities the unions do not appear to be willing to concede anything important in the way of working over time, while still actively pressing in many instances for increase of wages. A special appeal was made to avoid, in case of dispute, stoppage of work on tasks in which the Government was concerned and a commission was nominated by the Government to investigate and deal with any complaints that might arise. It is certain that for the successful prosecution of the war the output of material must not only be maintained but be greatly increased as the armies grow larger and the struggle more strenuous, and this can only be done by the most earnest endeavor on the part of both laborers and employers. The volume of orders for war materials of all kinds placed in this country is sufficient evidence that the foreign output cannot be pushed to an adequate amount. Some slow-going industries are, of course, very little affected, but the lack of men and specially skilled men is evidently becoming seriously felt

When a nation is in the throes of a terrific struggle for the maintenance of its place upon the earth it is evidently the duty of all its citizens to come to the rescue as best they can, the laborers by redoubled efforts and employers by meeting all reasonable requirements as to wages. How the adjustment of their mutual interests shall be made seems to be the chief difficulty, but it is certain that the lessening of industrial activity will be costly to England. In such a crisis the commandeering of necessary facilities by the Government seems to be the necessary step in case less vigorous measures fail to produce results. The conditions existing in England must of necessity prevail also in other warring countries. So nearly as the data at hand permit computation, between five and six million men are in the list of those killed, wounded or missing, and at least as many more are at the front. Subtraction of this huge number from the list of active workers, bearing in mind that the soldiery are taken from men at the most efficient age, of necessity produces grave industrial results and the situation must be met by vigorous measures. The burdens of war have to fall upon those who are not at the front in the form of great, even if not dangerous, efforts to keep the country's machinery running and its industries at a point where they can meet necessary requirements.

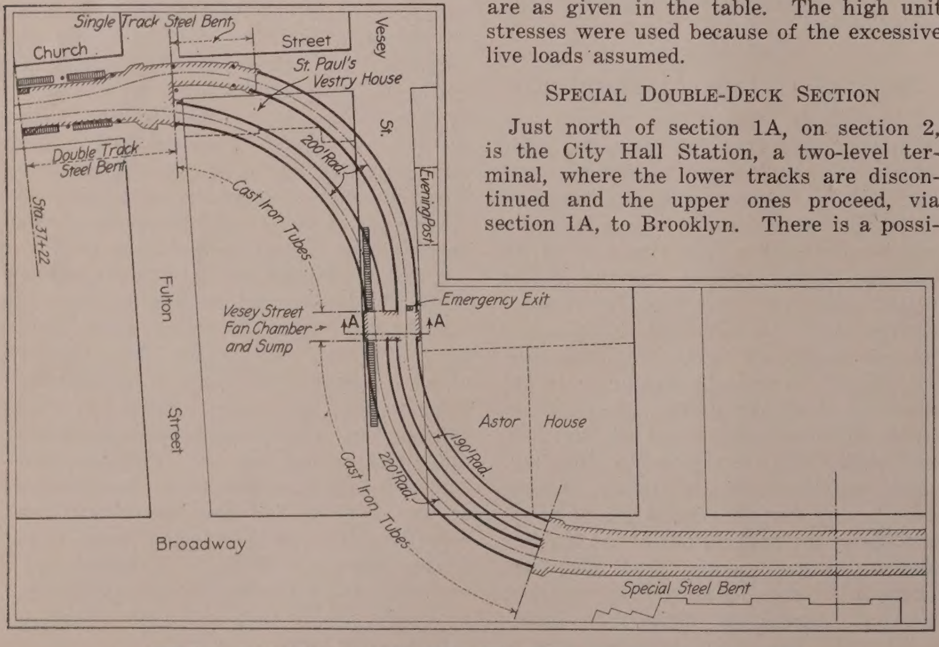
Short Subway Section in New York Involves Many Difficulties of Design

Both Steel-Bent Construction and Cast-Iron Tubes Used Where Line Swings from Broadway to Church Street at Vesey Street — Conflict with Possible Skyscraper on Astor House Site Avoided

By JULIUS GLASER
Acting Designing Engineer, Public Service Commission, First District, New York

INVOLVED in the design of section 1A, route 5, of the dual subway system of New York City were (1) the swinging of the line from one street to another parallel thoroughfare in the heart of the skyscraper district and the taking of as little private property as consistent with good alignment; (2) the use of single-deck and special double-deck steel-bent construction and of cast-iron tube tunnels; (3) the need of provision of ventilation, and (4) the necessity for supporting buildings over the subway and for underpinning foundations. There are present nearly all of the different conditions that usually confront the subway engineer, and in one of the shortest sections of the system. The section extends from a point in Church Street just south of Fulton Street to a point in Broadway just north of Barclay Street, passing under St. Paul's vestry house and cemetery, Vesey Street and the Astor House. The section is 1030 ft. long.

From an operating point of view it would seem that the connection between Church Street and Broadway should be more diagonal, with larger radii than shown on the accompanying drawing. In order to obtain easements at reasonable terms through St. Paul's churchyard, however, the subway had to be kept out of the cemetery as much as possible. The property occupied by the Astor House is owned by two different branches of the Astor family and the sharp curve from Vesey Street into Broadway is the result of confining the negotiations to only one of the owners. Besides these considerations, it was also necessary so to space the tracks that foundations for future buildings could be built between them and at the corners of the plots. The grades were dictated by the depth necessary to go below the Astor House, so that the tunnel would not interfere with a future basement and sub-basement.



CURVES OF VARIOUS RADII WERE REQUIRED TO FIT GROUND BEST

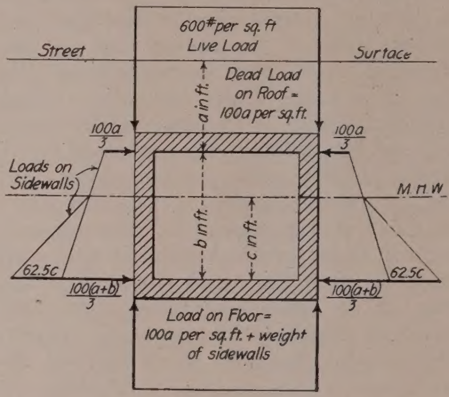
Steel-Bent Construction

The single-deck steel-bent construction extends 230 ft. northward from the south end of the section, the northerly 85 ft. of which are single-track and the rest double-track construction. The double-track portion is wider than necessary for operation, and is intended to act as a reservoir for ventilating purposes. The approach of a train in the tube pushes the air into this reservoir and forces it through the grating into the street, fresh air entering at the stations.

The single-track steel-bent construction is the simplest structure encountered. One of the illustrations gives the assumptions of loads and their application. On the roof there is assumed a live load of 600 lb. per square foot from surface cars and other moving loads, plus a dead load, consisting of the weight of the steel roof beams, concrete arches, earth backfill and street paving, estimated at an average weight of 100 lb. per square foot. The side walls are calculated to resist the horizontal component of the weight of the earth at any point. This is assumed to be one-third of the vertical pressure. They must also resist a water pressure depending on the relation of the structure to mean high water. The invert is figured to distribute uniformly, over the entire bottom, the dead load on the roof plus the weight of the side walls. The roof and invert are figured as simple-span beams, while the side walls are calculated not only as simple beams to resist the side pressure, but also as columns to carry the roof load. The fiber stresses used throughout, except for elevated column supports and construction carrying buildings, are as given in the table. The high unit stresses were used because of the excessive live loads assumed.

Special Double-Deck Section

Just north of section 1A, on section 2, is the City Hall Station, a two-level terminal, where the lower tracks are discontinued and the upper ones proceed, via section 1A, to Brooklyn. There is a possibility, however, that it may be desired to reverse the conditions and connect the lower tracks with the Brooklyn line. To provide for this contingency the special steel-bent portion of the subway at the north end of section 1A is built with two decks or floors. By bracing the side-wall columns with struts 13 ft. 2 in. above the lower base of rail, and removing the upper track floor, the trains from Brooklyn can use the lower level of the City Hall Station. The design for this section is the same as that described previously, except that the side walls are figured for the worst of two conditions: one with the upper track floor in place, and the other with the struts in place and floor removed. This special steel-bent construction is 280 ft. long, the difference in the two levels varying and the two coming together at the beginning of the tube section.



ASSUMED LOADING ON BENT CONSTRUCTION

The steel-bent construction is waterproofed on the bottom and sides to a point 2 ft. above mean high water by two layers of brick laid in asphalt mastic and two-ply waterproofing consisting of felt and coal tar pitch. Above this point on the side walls

PERMISSIBLE FIBER STRESSES IN STEEL AND CONCRETE AND BEARING ON SOIL

	Lb. per sq. in.
Steel embedded in concrete:	
Bending	25,000
Shear	15,000
Steel, not embedded in concrete:	
Bending	20,000
Shear	10,000
Shop rivets:	
Shear	15,000
Bearing	30,000
Field rivets	20 per cent less
	Lb. per sq. ft.
Bearing on soil:	
Above water	8,000
Below water	6,000
	Lb. per sq. in.
Reinforced concrete construction:	
Compression in concrete	600
Shear in concrete	70
Adhesion, concrete to steel	100
Tension in steel	20,000

Compression in reinforced-concrete columns, lb. per sq. in.:

$$550/[1 + (1/600)\ (l/t)^2]$$

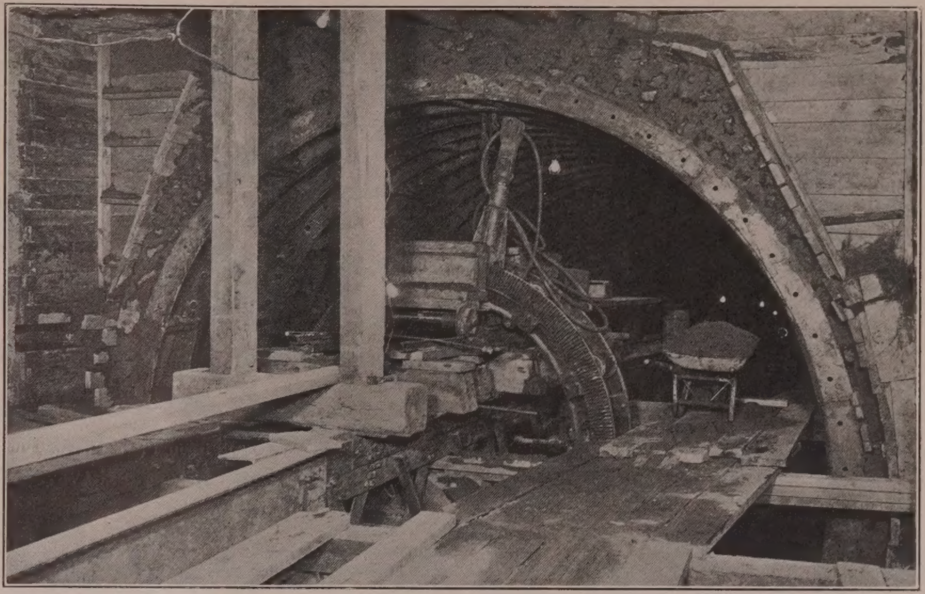
Compression in steel columns, lb. per sq. in.:

$$20{,}000/[1 + (1/8000)\ (l/r)^2]$$

water-admitting cracks are prevented by ⅝-in. longitudinal rods laid continuously outside of the steel. The roof is waterproofed by three-ply felt and pitch. The waterproofing on the bottom is protected by 6 in. of concrete and that on the sides and roof by 4 in.

CAST-IRON TUBE TUNNELS

Cast-iron tube tunnels connect the steel-bent types of construction, as shown in the plan. This construction is entirely on curves; these are circular in the main, with radii as shown, but in order to fit the ground to best advantage it was necessary to compound the easterly track with a stretch of 200-ft. radius at the Broadway end and another of 300-ft. radius at the Church Street end. There is also a 75-ft. transition curve in the westerly track west of the fan chamber on Vesey Street. The tunnels are composed of rings 1 ft. 10 in. wide and 20 ft. in diameter. The curvature was accomplished by taper rings and straight rings. Besides the curvature in the alignment it was necessary to change the grade under the Astor House. This was done by inserting taper rings in place of some of the straight pieces, thereby changing the direction of the vertical tangents without impairing the correct curvature of the alignment. The strength of this tube is somewhat in excess of the requirements, since it has the same resistance as the tube under the Harlem River. That tube was figured for a 50-ft. head of water and the resultant thickness of the cast iron was considered the minimum consistent with good practice.



CAST-IRON TUBE ERECTOR AND METHOD OF FILLING AROUND TUBES

FAN CHAMBER

Where the curves reverse in Vesey Street is located a fan chamber. This chamber was designed to accommodate four fans capable of discharging 10,000 cu. ft. of air per 100 ft. of grating per minute. The function of these fans is to renew the air in the subway during the summer nights when the traffic is at a minimum and train action cannot be depended on to force the air out of the grating at the south end of the section. The fans will also be operated in case the trains are stalled, due to accident, or in case of fire, to remove smoke and gases.

This plant, operating at its full capacity, will renew the air in this section in ten minutes. The sump and pump chamber, located between the tubes at the lowest point of the section, drains the entire section in case water should find its way in through the ventilating gratings or a leak in the waterproofing. There is also an emergency exit from the fan chamber to the north side of Vesey Street. This exit is located on the sidewalk near the curb and is reached by means of ladders from the subway.

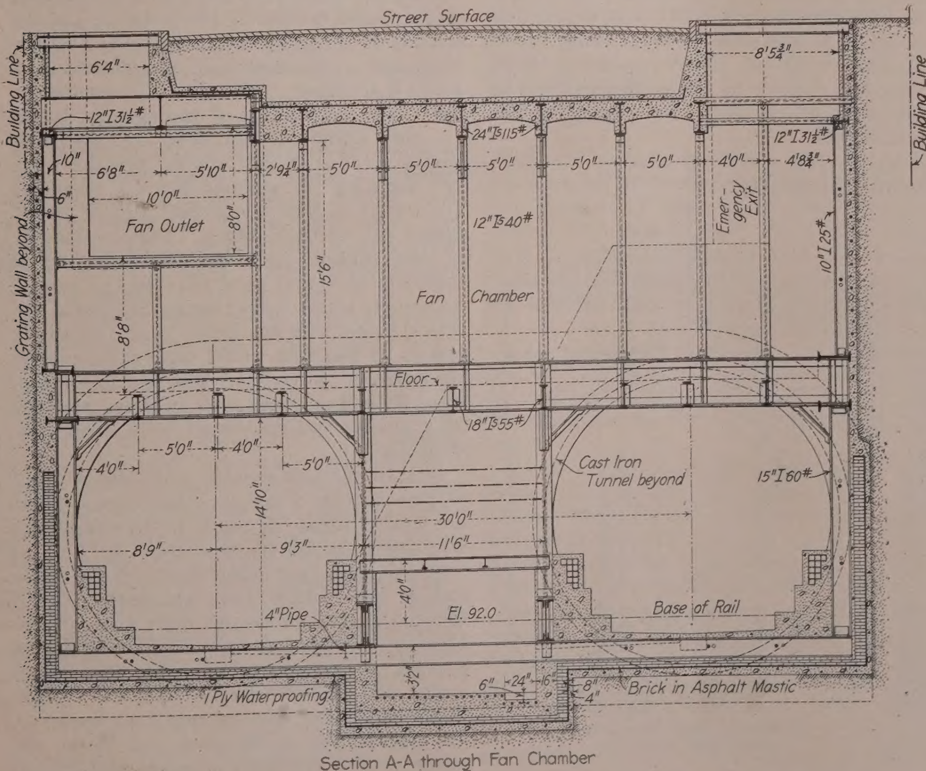
Columns supporting the elevated railroad structure on Church Street and not located directly on the subway are underpinned to subgrade; those which have to be carried on the roof are taken care of by special girders and columns, designed in accordance with stresses approved by the elevated railroad company.

When it is necessary to support a building or underpin a foundation in a manner out of the ordinary, the contractor submits a scheme, which is examined and passed upon by the engineering department of the Public Service Commission. This consists mainly of investigating the safety of the building during construction, taking into consideration the strength of the materials used and their conformity to the requirements of the Building Department, and whether or not the underpinning brings undue pressure on the subway structure after completion. In this section there are two buildings which had to be considered in this way—the St. Paul's vestry house and the Evening Post Building.

SUPPORTING ST. PAUL'S VESTRY HOUSE

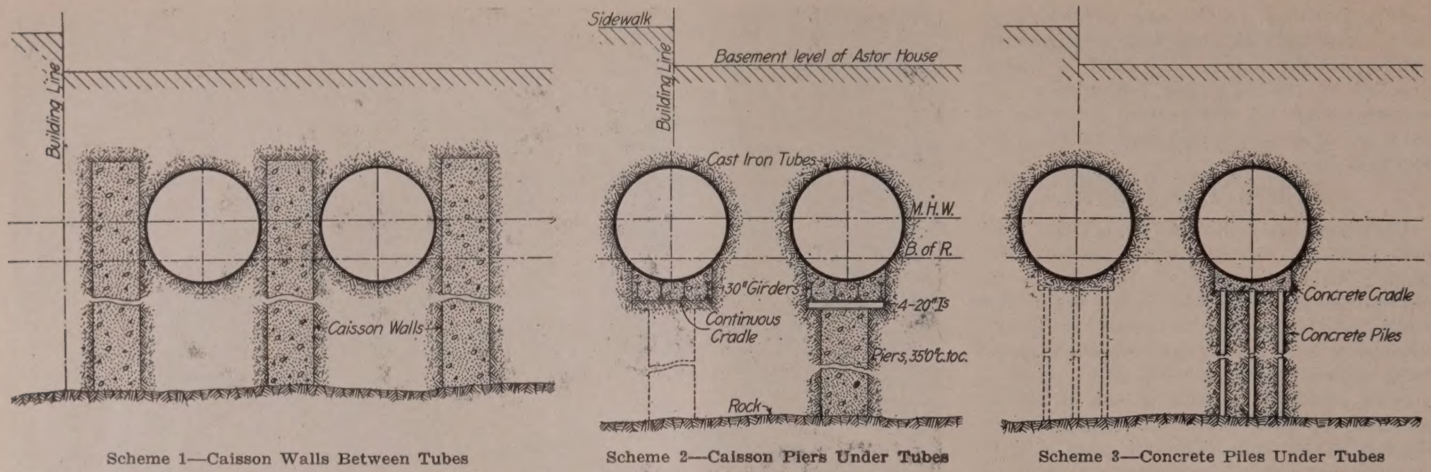
St. Paul's vestry house, on Church Street between Fulton and Vesey Streets, had to be supported before the excavation under it was begun, because the excavation came so close under the walls that ground was likely to be lost under the footings. The contractor proposed to anchor continuous, longitudinal, latticed girders against the walls to be supported; then excavate 5-ft. square pits under the walls, where possible, and along the lines of the subway to subgrade or until he struck water, from which point piles were to be sunk below subgrade and the pits filled with concrete, forming piers on which the walls would rest. The function of the longitudinal girders was to carry the load of the walls from pier to pier. In this manner the piers could be built at convenient points, one at a time, without shoring the building. Finally, latticed cross girders were to be inserted over the top line of the subway, resting on those piers built along the side lines. These girders were to support those walls which came directly on the subway.

The general scheme of this proposition fulfilled the first two conditions previously mentioned, namely, the safety of the building and the pressure on the subway. Exception was taken to the sinking of piles



Section A-A through Fan Chamber

FAN CHAMBER OCCUPIES NEARLY FULL WIDTH OF VESEY STREET



Scheme 1—Caisson Walls Between Tubes

Scheme 2—Caisson Piers Under Tubes

Scheme 3—Concrete Piles Under Tubes

THREE DESIGNS FOR PROTECTION OF TUBES AGAINST POSSIBLE FUTURE EXCAVATION FOR SKYSCRAPER ON ASTOR HOUSE SITE

Scheme 2 was adopted as the most economical compatible with good practice

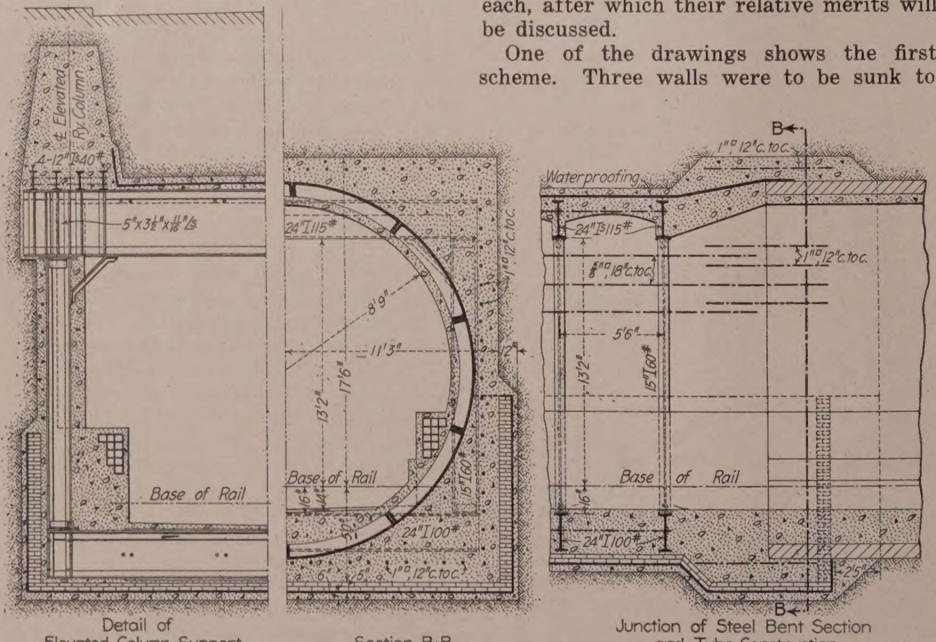
under some piers and not under others, however, and also to be latticed cross girders which would support those walls located directly over the subway. It was ordered that all piers be built to subgrade, because the contractor's method did not equalize the pressure on the ground and it was feared that unequal settlement might crack the walls of the building. The cross girders had to be redesigned and changed to plate girders for proper strength and conformity to the building law. The piers and girders were then rearranged in the interests of economy.

Underpinning the Evening Post Building

The Evening Post Building, fifteen stories high, is located just west of the fan chamber, and its foundations were endangered by the excavation for the subway. The contractor's scheme in this case fulfilled all conditions except that of undue pressure on the subway.

It is best to describe this underpinning by reference to the accompanying drawing, which was finally adopted, and then point out wherein it differs from the original proposal. The 30-in. girders are placed on top of 20-in. grillage beams, and anchored securely to them. Next, concrete piers 5 ft. square are built, reinforced by 6-in. steel beams on the side nearest the tubes. These piers act not only as underpinning for the building foundation, but also as reinforced-concrete beams, protecting the tubes from undue pressure. The function of the 30-in. girders is to distribute the load of the footings to the adjacent soil, while the pier is being built beneath.

The contractor's drawings showed the piers built only to the water level on piles. While this would have underpinned the footing safely, it would not have prevented the pressure of the footing behind the pier from coming on the subway.



Detail of Elevated Column Support

Section B-B

Junction of Steel Bent Section and Tube Construction

JUNCTION OF TUBE AND BENT CONSTRUCTION IN CHURCH STREET

The design was complicated by the necessity for supporting the elevated railroad structure

Designing for Possible Skyscraper on Astor House Plot

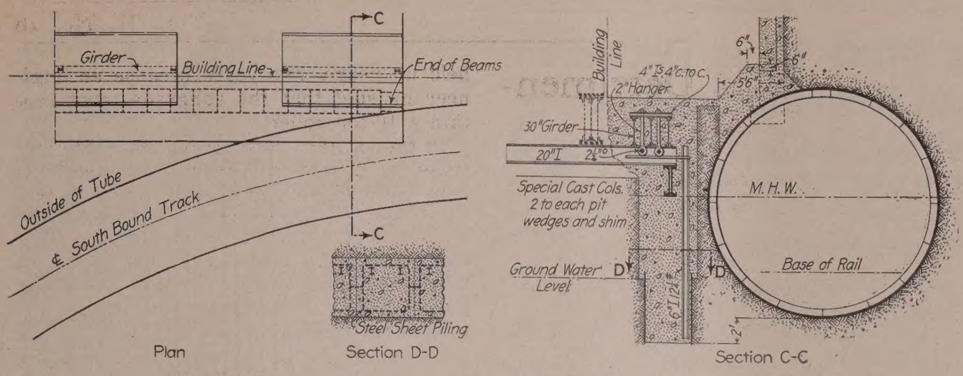
Special provision has been made at this time for the possible future erection of a tall building on the site now occupied by the Astor House, with sub-basements and foundations extending below the subway tubes, so that it will not be difficult to keep trains safely in operation during the construction of such a building. The tubes are supported in such a way that excavation carried on at any point in their vicinity will not disturb them. Three schemes were proposed. Following is a description of each, after which their relative merits will be discussed.

One of the drawings shows the first scheme. Three walls were to be sunk to bedrock, one on each side and one between the tubes. They were to be continuous and extend a little above the tops of the tubes, protecting them while excavation is carried on outside of this inclosure. The second scheme, which is the one adopted, consists of sinking to rock 4 x 8-ft. caisson piers, about 35 ft. on centers, along the center lines of the tubes, with 30-in. girders from pier to pier. These girders, covered by concrete, form a continuous cradle on which the tubes are built. The third scheme contemplated sinking concrete piles about 5 ft. on centers in each direction and supporting the tubes on the concrete saddles forming the caps of the piles.

The only advantage of this last scheme was low cost, which was estimated at $22,000. If the excavation was carried on far below the tubes, the piles, acting as long columns, would have to be braced. The tubes themselves would have to act as beams spanning from saddle to saddle, and the basement of a future building under the tubes would be cut up by these piles. The second scheme was estimated at $46,000. The tubes, being supported on a continuous cradle would receive no extra stress, and the spacing of the piers would not spoil a future basement. The first plan would fully protect the tubes, because all excavation must be done outside of the exterior walls. Its cost would be $250,000, but the walls would serve as underpinning for the present building by placing girders spanning from wall to wall above the lines of tubes under the building walls. The availability of the caisson walls for future building foundations would have reduced the cost of easement, which might be an argument for this scheme. On the other hand the entire corner of the plot would have been cut off for basement purposes. The second scheme, from an engineering point of view, was the most economical consistent with good construction.

Within the last month, since the writing of this article, a contract has been let for the construction of such a skyscraper as was provided for on this site.

In the two-track construction at the south end of the section there are twenty ducts for the power cables on each side of the subway, so arranged that their bank forms a walk for passengers to be used when trains are stalled between stations. These ducts have been split up into four banks of ten ducts each in the cast-iron tubes, because this is the most economical arrangement for this section. At the north end of the section the ducts are brought together



UNDERPINNING FOR EVENING POST BUILDING IN VESEY STREET

again and massed in the center of the structure in order to save the excavation required if they were banked on the sides, as in the first case. The ducts are distributed in manholes located at the extremities of the cast-iron tube construction.

The estimated cost of section 1A is $1,104,00. The contract was let to the lowest bidder, Frederick L. Cranford, Inc., of New York City, for $982,000, the bids ranging from this figure up to $1,564,000 among nine contractors. There will be 44,500 cu. yd. of excavation. The principal items of material are 9300 cu. yd. of concrete, 800 tons of steel and 4350 tons of cast iron.

The design of the section was supervised by the writer in the engineering department of the New York Public Service Commission, First District, of which Alfred Craven is chief engineer; Robert Ridgway, engineer of subway construction; Daniel L. Turner, deputy engineer of subway construction, and Sverre Dahm, principal assistant engineer.

Track Concreting Costs Vary with Mixing Methods

Comparative Figures for Batch Machine, Continuous Mixer and Hand Mixing for Pavement of Street Railway Right of Way

By S. GAUSMANN
Formerly Roadmaster of Surface Lines, Brooklyn Rapid Transit Company, New York

THE following costs of concreting in connection with paving between modern street railway tracks are based on doing work with no car interference. These costs will be somewhat increased under car operation, with machines outside the tracks, or decreased with machines of larger capacity.

The freight rates for hauling machines to and from work are in accordance with rates approved by the Public Service Commission of the State of New York, First District, and include the total cost of maintenance of the car equipment, cost of trackage and overhead line rights and office expenses of the freight department. These rates vary according to the length of haul, the figures given being for an average haul. This haulage cost would be considerably reduced where the track department does its own handling of material, etc., and where only the wages of crews are charged against it instead of having the freight department make a general charge per car-mile.

COST WITH BATCH MIXER

The batch mixer, for which the following costs for operation are given, is of 0.5 cu. yd. capacity. It can be bought for $1300, mounted on a car, and is electrically operated as to mixing only, so that it must be hauled to and from the work daily.

The number of men employed and their rates per hour in operating a machine of this character are: One assistant foreman, 25 cents; one operator, 25 cents; four laborers, 20 cents; six laborers, 18 cents; fourteen laborers, 16 cents; one checker of time and material, 15 cents, or a total cost of $47.50 for one day of ten hours. This cost is distributed to the various operations as shown in Table 1.

TABLE 1.—COST PER DAY FOR GANG ON ONE BATCH MACHINE

Operation of the machine	$2.50
Watching mix and dumping	4.25
Handling material to the machine	13.50
Removing and placing the track	22.10
Ramming and tamping under the rail	3.85
Checking	1.50
	$47.70
Add other charges:	
Overtime for cleaning	$0.90
Interest on investment	.58
Freight to and from work	6.25
Lubricants, repairs and incidentals	2.33
	$10.06
Total	$57.76

A gang of this size will average in a ten-hour day approximately 675 ft. of single track with concrete 7 in. deep. The area, with 6 x 8-in. x 8-ft. ties spaced 2 ft. center to center is equal to 94.22 cu. yd., making the unit cost $0.613 per cubic yard, exclusive of material.

COST WITH CONTINUOUS MIXER

A good continuous mixer of a standard make can be purchased for $560. Although such mixers are supplied on wheels for use at the side of the track, a good car with old pony wheels and a wooden frame can be made for approximately $30, thus bringing the total cost to less than $590. This cost is for a gasoline-operated machine, but an electrically operated one is preferable. Provided an old motor is obtainable, the first cost will vary but little from gasoline, whereas the cost of operation will be less.

As a machine of this kind is easily derailed it need not be removed from the street daily, and can be left on the work continuously ready for use at any time, with no outlay for freight charges until it is required at other points.

The number of men employed, and their rates per hour, in operating one of these machines are: One assistant foreman, 25 cents; one operator, 25 cents; two laborers, 20 cents; three laborers, 18 cents; eight laborers, 16 cents; one checker of time and material, 15 cents, or a total cost of $28.70 for a ten-hour day. This cost is distributed to the various operations as shown in Table 2.

TABLE 2.—COST PER DAY FOR GANG ON CONTINUOUS MIXER

Operation of machine	$2.50
Handling material to machine	10.20
Distributing in track	12.10
Ramming and tamping under rail	2.40
Checking	1.50
	$28.70
Add other charges:	
Overtime for cleaning	$0.50
Interest on investment	.26
Freight to and from work	1.25
Gasoline, oil and repairs	2.25
	$4.26
Total	$32.96

This gang will average 430 ft. of single track per ten-hour day, with concrete 7 in. deep. This area, with 6 x 8-in x 8-ft. ties spaced 2 ft. center to center is equivalent to 60.054 cu. yd., making the unit cost $0.5488 per cubic yard, exclusive of material.

MIXING BY HAND

Of course, in mixing by hand the number of men employed may vary, but for an illustration we may assume that as many are employed as on the continuous mixer, exclusive of the operator. The cost then would be distributed to the various operations as follows:

TABLE 3.—MIXING BY HAND

Distributing material and mixing	$10.50
Distributing in the track	11.80
Ramming and tamping under the rail	2.40
Checking	1.50
	$26.20

This number of men in a ten-hour day will average 225 ft. of single track with concrete 7 in. deep which, with 6 x 8-in. x 8-ft. ties spaced 2 ft. center to center, amounts to 32.77 cu. yd., equivalent to a unit cost of 80 cents per cubic yard.

The foregoing figures were obtained from many years' experience in this line and from carefully collected data. While they may not apply to all locations, the costs can be easily adjusted to meet any conditions from the information given.

Tests of Six Types of Reinforced-Concrete Fence Posts

SIX TYPES of reinforced-concrete fence posts have been tested under the direction of the committee on signs, fences and crossings of the American Railway Engineering Association. All posts were made of 1:2:4 concrete, using broken stone or gravel aggregate not more than ½ in. in size, and were about one year old when tested. Two round, one square, one half-round, one T-shaped, one triangular section were used, all 7 ft. long, all of tapering outline except the last. The reinforcement consisted of various sizes of steel wire or rods, and the lateral dimensions varied from 5 to 6½ in. at the base to 3 or 4½ in. at the top. Impact, cross-bending and cantilever bending tests were made. The best results in all cases were given by the round tapering post 5½ in. in diameter at the base and 4 in. in diameter at the top, reinforced with six No. 8 wires. The other smaller circular post reinforced with five wires also gave very good results. The tests indicated that this form of post, with several reinforcing wires, or the T-form with three ¼-in. rods, was the strongest and most reliable.

Misuse of a Good Paving Material Is Detrimental to Florida Road Development

Brick Roads Only Nine Feet Wide, Laid on Sand Foundation with Sand Filler, Rapidly Become Rough and Require Relaying

By CHARLES E. FOOTE
Lately with Florida Good Roads Association

"WHEN you begin to talk about concrete foundations for brick roads in Florida you are simply trying to kill brick as a road material," was the remark of the representative in Florida of large brick manufacturing interests who sell most of the brick that goes on Florida highways.

A careful investigation showed the accuracy of the statement. Any material which will make a foundation will receive and maintain a surfacing much less expensive than brick, and brick will naturally cease to be used on Florida roads.

FLORIDA'S PRIMITIVE METHODS OF ROAD-BUILDING ALLOW BRICK TO BE LAID ON SAND FOUNDATION WITH A SAND FILLER BETWEEN JOINTS

EXTENT OF BRICK ROADS

There is a considerable mileage of brick roads in Florida, most of it, however, in widely separated sections. Duval county has brick roads leading in four or five directions from Jacksonville to adjoining county lines or nearly so. St. Johns county has a brick road extending practically the entire length of the county, from Duval county on the north, through St. Augustine, the county seat, to Volusia county on the south. This forms part of the Quebec and Miami highway. Seminole county has several brick roads branching out in different directions from Sanford for different distances; Alachua county has several sections of brick roads which radiate from Gainesville, and Hillsboro county probably has, or will have, a greater mileage of brick roads than any of the other counties when its system of highways is completed, and the balance of the proceeds of a million-dollar bond issue expended. There are also numerous other counties and road districts where short stretches of brick road have been constructed.

In Duval county most of the brick roads are built 14 or 16 ft. wide. In Hillsboro county about one-third of the mileage is 16 ft. wide—in some cases wider, in the small villages through which the roads pass. But by far the greatest mileage of brick roads in Florida is constructed to a width of 9 ft., and, except in rare instances, without turnouts.

The construction of these brick roads is exceedingly primitive. The soil is usually a very fine sand. A recent test of the sand in what appeared to be an average locality, showed that about 75 per cent of it would go through an 80-mesh sieve. Generally the sand is sharp, and compacts readily when saturated with water. When dry it is loose and hard to travel over, either with vehicle or on foot.

The topography of the country is so nearly level that little grading is necessary. In very low places fills are made so as to bring the surface above an ordinary high water line, but instances are numerous where, after a succession of rains, the water covers the road for days at a time.

The brick is laid directly on a sand subgrade. This subgrade is prepared by thoroughly saturating the sand, and rolling. This compacting is supposed to be performed with at least a 10-ton roller, but instances are numerous in which the authorities have been convinced by the contractors that it was neither necessary nor desirable to have the subgrade so heavily rolled. In a section of Alachua county a contract was held up nearly two years because an engineer insisted that the subgrade must sustain a 10-ton roller.

In the earlier construction, the curb consisted of a row of bricks laid lengthwise with the road, kept in place by a 2-in. plank, which was supported by stakes driven into the sand. In most of the recent construction a concrete curb is employed. This concrete curb is made at central plants, of which there are two or three in the State, principally at Jacksonville and Tampa. It is made in sections about 5 ft. long, and is set 18 to 20 in. in the sand, the top being flush with the surface of the brick.

The brick is placed on the sand subgrade, and between the curbs. The brick is of the usual shape and size of paving block, but without lugs, or other device for maintaining uniform spaces. They are laid flat, and somewhat separated so that a sand filler can be broomed in between them.

LIFE OF ROADS

When properly constructed these roads last for two or three years without much expense for repair or maintenance. During that time, however, the periodical torrential rains of the region beating down on the brick, force quantities of water through the sand filler into the subgrade, gradually disintegrating and weakening it in spots, so that the surface becomes wavy. Traffic intensifies this condition, until, if the road is to be kept in good condition, it becomes necessary to take up the brick, prepare a new subgrade, and relay the surface, all at an expense approximating 30 to 35 per cent of the entire original cost of the road. In Seminole county the statement was made than 3½ miles of a 7-mile stretch of road had to be taken up and relaid before the end of the first season. By some, the reason was given as the excessive rains; by others the imperfect original compacting of the subgrade; still others claimed that the ruts in the old sand road had not been properly filled in.

Riding over these brick roads, especially after a shower or in the early morning, one is impressed with the fact that from a quarter to a half of the brick are soft; what would be called "culls," if submitted to standard tests. The fact that few counties in Florida employ a county highway engineer is, of course, responsible for this condition.

COST

The average cost of these 9-ft. brick-on-sand roads is stated at about $1000 per mile per foot of width; with the addition of the concrete flush curb about $1500 per mile is added, making the cost of the road approximately $2 per square yard. This figure was given by William Pannill, the representative of brick interests previously mentioned. Mr. Pannill also stated that most of the brick used in the construction of Florida roads comes from Augusta, Ga., Birmingham, Ala., and Chattanooga, Tenn.

A regular publicity propaganda is maintained by the brick interests in the various sections of Florida where good roads sentiment is strongest. Inspired newspaper articles stating the advantages of brick for roads are so worded and carry such an impression that in some instances county commissioners have been obliged to declare themselves in favor of brick to save bond issues from defeat.

Brick roads, however, are about the least economical and the least logical that counties and road districts in Florida can put down. While from 50 to 75 per cent of the brick block will last for years, the original cost is high, and the numerous relayings make the upkeep very expensive. The idea of bonding practically to the limit to build a few miles of road when many miles are needed; and when the greater mileage could be built of a material which will last as long as the brick and without the excessive cost of maintenance, does not appeal to the fiduciary sense of the practical observer. Spending $2 a square yard on a pavement for county roads, except those in the vicinity of the largest cities in the country, is practically unheard of in any other State.

DANGERS OF NINE-FOOT ROAD

The 9-ft. road constitutes a constant menace, and has been demonstrated to be exceedingly dangerous. The sand shoulders are usually originally compacted; but as soon as they dry out they are again the same soft sand. Careful driving keeps an automobile on a strip of 9-ft. paving, but even a slight variation, or a trifling irregularity of the steering apparatus, and one front wheel strikes the soft sand with disastrous results. Few machines and few drivers, going at a rate of speed natural to be taken on a brick road, can stand the strain of getting a wheel off the paved strip. The wheel, plowing into the soft sand, will almost invariably take the steering wheel out of the hands of the driver, or will break the steering apparatus, and either ditch or upset the car. Examples of this are numerous.

The passing of automobiles on these 9-ft. roads is attended with much difficulty. If a favorable place can be found the lighter car usually takes the sand, and then is pulled back on the road by the heavier car, which has remained on the brick. Various other methods are employed, depending on the resourcefulness and ingenuity of the drivers. In every such instance, however, it is necessary that both cars come to a full stop and figure out, with more or less loss of time and strain of temper, the most available method of effecting the passage. There has been much talk of seeding the sand shoulders of these roads with Bermuda grass, which is said to form a firm sod.

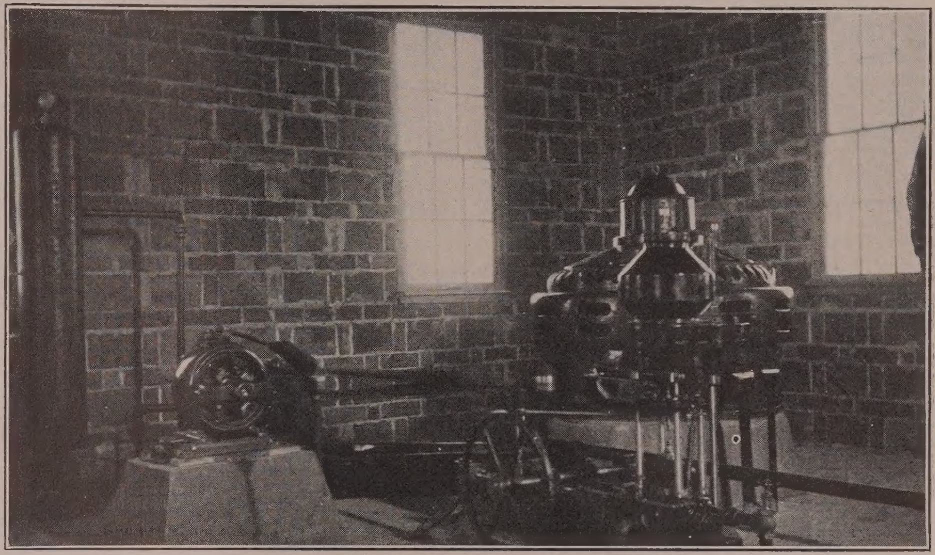
Will P. Blair, secretary of the National Paving Brick Manufacturers' Association, in a recent letter, advocates using the money now spent on curbs on Florida brick roads in putting in a filler of cement grout, a 1:1 mixture. This method would make the road waterproof and prevent the disintegration of the subgrade and the attendant necessity for building a new foundation and relaying the brick. Those opposed to Mr. Blair's ideas argue that the monolithic character of a road so built would make it difficult to remove soft or defective brick when necessary.

In the writer's judgment, brick has no legitimate place on Florida country roads at the present time; nor will it have until the population of the State is ten times what it is to-day. When the wonderful natural resources of the State shall have been developed; when its arable lands shall be under full cultivation; when its capacity for production and entertainment shall have reached half their possibilities, perhaps a few main roads of brick may be justifiable. Until then they are expensive, inadequate, and ruinous to the best interests of Florida.

Hydroelectric Plant to Supply Town of 400 Population

A SMALL hydroelectric plant, designed to give satisfactory service to a town of 400 population and at the same time return a reasonable earning on the investment, was recently completed at Waucoma, Iowa.

It consists of a concrete dam of the ordinary reverse surge type, 193 ft. long and 12 ft. in height, giving a working head of 9 ft., and a power house built of vitrified hollow blocks, with a reinforced-concrete floor and a roofing of asbestos shingles. The source of supply is a small, spring fed stream which runs through the center of the town with an average flowage of about 16 sec.-ft. For developing the power there is a 20-in. Leffel wheel, direct connected to a 37-kw, three-phase, 60-cycle alternating-current generator. There is also a 30-in. Leffel wheel belted to the generator shaft and connected with a friction clutch to be used in flood times or to assist over a peak load. These wheels are governed by a Lombard oil-pressure governor.



GENERATING EQUIPMENT OF SMALL TOWN HYDROELECTRIC PLANT

The plant was designed with a strict view to maintaining balanced proportions and to meet with local conditions. Great care was exercised to purchase the correct machinery for the particular purpose and that which would be neither too large nor too small. The plant is nearly automatic in operation and gave promise of a net annual earning of 10 per cent during the first month it was operated. Since then the load has been increasing to such an extent that an earning of 15 per cent net is expected for the first full year of operation.

This plant was designed and constructed by Arthur H. Latimer, engineer and constructor of Des Moines, Iowa.

FREIGHT MOVEMENT through St. Marys Falls Canal, at Sault Ste. Marie, Mich., amounted to 55,369,934 short tons for the season of 1914, a decrease of 24,348,414 tons, or more than 35 per cent from the record established in 1913. The valuation of the freight was $634,800,268, a decrease of 26 per cent. The value of iron ore shipped, which in 1913 constituted nearly 20 per cent of the entire value, fell off nearly 50 per cent, and was the least in ten years with the exception of 1908.

Commerce Board Presents Steam-Road Statistics

Revenues Decreased in 1914 While Expenses Increased—8 Per Cent Fewer Employees Per 100 Miles than in 1913

USUALLY the abstract of statistics of the steam railways of the United States issued by the Interstate Commerce Commission has made its appearance in July. This year the information, which covers the year ended June 30, 1914, is available three months earlier. The figures may be slightly modified before final publication; they do not cover switching and terminal companies, nor carriers having revenues of less than $100,000 for the year. Noticeable in the returns are a decrease in revenues with an increase in expenses, resulting in a large increase in the ratio of operating expenses to operating revenues, and a decrease of 8 per cent in the number of employees per 100 mi. of line.

TRACKAGE, EQUIPMENT AND NUMBER OF EMPLOYEES

Mileage.—The roads covered represented 247,397.59 mi. of line operated, including 11,298.88 mi. used under trackage rights. The aggregate mileage of railway tracks of all kinds covered by operating returns for these roads was 377,102.45 mi. This mileage was thus classified: Single track, 247,397.59 mi.; second track, 27,604.12; third track, 2696.03; fourth, fifth and sixth tracks, 2071.45; yard track and sidings, 97,333.26. These figures indicate an increase of 7522.65 mi. over corresponding returns for 1913 in the aggregate length of all tracks, of which increase 2995.24 mi., or 39.82 per cent, represent yard track and sidings.

Equipment.—There were 64,760 locomotives in service on June 30, 1914, an increase of 1382 over the previous year. Of these 14,612 were passenger, 38,752 freight, 10,081 switching, and 1315 unclassified.

The total number of cars was 2,503,822, or 58,314 more than on June 30, 1913. This equipment was thus assigned: Passenger service, 53,466 cars; freight service, 2,325,647; company's service, 124,709.

The 2,325,647 cars in freight service were classified as per Table 1.

The average number of locomotives per

TABLE 1—CLASSIFICATION OF FREIGHT CARS

Description	Number	Aggregate capacity, tons
Box	1,043,796	36,622,074
Flat	146,133	5,214,949
Stock	82,971	2,597,278
Coal	899,314	40,583,490
Tank	8,530	340,722
Refrigerator	48,886	1,577,973
Other cars in freight service	96,017	4,040,612
Total	2,325,647	90,977,098

1000 mi. of line was 262, and the average number of cars, 10,121. The number of passenger-miles per passenger locomotive was approximately 2,365,000, and the number of ton-miles per freight locomotive was approximately 7,369,000.

Employees.—The total number of persons on the payrolls of these roads on June 30, 1914, was 1,695,483, or an average of 685 per 100 mi. of line. As compared with corresponding returns for June 30, 1913, there was a decrease of 119,756 railway employees. There were 61,365 enginemen, 64,335 firemen, 47,621 conductors, 135,853 other trainmen and 37,671 switch tenders, crossing tenders and watchmen. The total amount of wages and salaries paid was $1,373,422,472.

TABLE 2—EXPENDITURES FOR ADDITIONS AND BETTERMENTS AND FOR NEW LINES AND EXTENSIONS

Investment to June 30, 1914			$16,936,697,840	
Investment to June 30, 1913			16,424,359,514	
Increase 1914 over 1913				$512,338,326
	Expenditures for additions and betterments	Expenditures for new lines and extensions		
From cash or other working assets	$330,529,491	$61,370,851		
From special appropriations	43,616,529	114,129		
Through issue of securities	138,135,821	60,062,788		
Not assigned to any of the above classes	3,779,449	157,910		
Total	$516,061,290	$121,705,678	$637,766,968	
Miscellaneous charges not classified			851,008	
Total expenditures during year		Credits	$638,617,976	
Property retired or converted		$88,104,245		
Adjustments		8,524,764		
Difference between record value of grantor and purchase price of grantee in cases of roads sold, merged, consolidated, etc		29,650,641		
Total			126,279,650	
Net increase during year				$512,338,326

The complete report will include summaries showing the average daily compensation of eighteen classes of employees for a series of years, and also the aggregate amount of compensation reported for each of the several classes.

CAPITALIZATION AND EXPENDITURES

Capitalization.—On June 30, 1914, the par value of the amount of railway capital outstanding was $20,247,301,257. This amount includes capital held by the railway companies concerned, as well as by the public. Of the total amount of such capital outstanding there existed as stock $8,680,759,704, of which $7,304,479,846 was common and $1,376,279,858 was preferred; the remaining part, $11,566,541,553, representing funded debt, consisted of mortgage bonds, $8,496,370,538; collateral trust bonds, $1,182,683,530; plain bonds, debentures and notes, $1,142,016,070; income bonds, $254,230,505; miscellaneous funded obligations, $72,700,640, and equipment trust obligations, $418,540,270.

Of the total capital stock outstanding for the roads under consideration, $3,019,020,981, or 34.78 per cent, paid no dividends. The amount of dividends declared during the year (by both operating and non-operating companies represented in this statement) was $451,263,197, being equivalent to 7.97 per cent on dividend-paying stock. The average rate of dividends paid on all stocks outstanding pertaining to the roads under consideration was 5.20 per cent. The increase in dividends declared during the year, being $82,656,870, is principally accounted for by increased dividends declared by the Union Pacific Railroad and the Central Pacific Railway; the dividends declared during the year by these two companies were more than $86,000,000 greater than those of the preceding year. No interest was paid on $1,331,581,452, or 11.94 per cent, of the total amount of funded debt outstanding (other than equipment trust obligations).

Investment.—The expenditures for additions and betterments, as well as the expenditures for new lines and extensions, during the fiscal year 1914 are analyzed in Table 2.

SERVICE, REVENUE AND EXPENSES

Public Service.—The number of passengers carried during the year was 1,053,138,718, an increase over the previous year of 19,459,038. The number of passengers carried 1 mi. was 35,258,497,509. The corresponding return for 1913 was 682,624,529 less. The number of passengers carried 1 mi. per mile of road was 144,278, as against 143,067 for the preceding year.

The number of tons of freight carried was 1,976,138,155, while the corresponding figure for the previous year was 2,058,035,487, the decrease being 81,897,332. The ton-mileage was 288,319, 890,210, as compared with 301,398,752,108 for 1913—a decrease of 13,078,861,898. The number of tons carried 1 mi. per mile of road was 1,176,923, as against 1,245,158 for the preceding year. The average number of tons of freight per train-mile was 451.80. The corresponding figure for the preceding year was 445.43.

The average receipts per passenger per mile, as computed for the year ended June 30, 1914, were 1.982 cents; the average receipts per ton per mile, 0.733 cent. The passenger-service train revenue per train-mile was $1.34.496; the freight revenue per train-mile was $3.30.845. The average operating revenues per train-mile were $2.45.024. The average operating expenses per train-mile were $1.76.917. The ratio of operating expenses to operating revenues was 72.21 per cent.

Revenues and Expenses.—The operating revenues of the railways represented (average mileage operated, 245,624.55 mi.) were $3,047,019,908; their operating expenses were $2,200,313,159. The corresponding returns for 1913 (average mileage operated 242,657.12 mi.) were: Operating revenues, $3,125,135,798; operating expenses, $2,169,968,924. The figures in Table 3 present a statement of the operating revenues for 1914 in detail.

TABLE 3—OPERATING REVENUES

Freight revenue	$2,114,697,629
Passenger revenue	700,403,353
Excess baggage revenue	7,477,092
Parlor and chair car revenue	677,631
Mail revenue	55,062,961
Express revenue	75,541,569
Milk revenue (on passenger trains)	9,654,664
Other passenger revenue	6,229,246
Switching revenue	33,171,335
Special service-train revenue	1,777,780
Miscellaneous transportation revenue	6,995,174
Total revenue from operations other than transportation	32,930,397
Joint facilities—Dr.	1,242,795
Joint facilities—Cr.	3,643,872
Total operating revenues	$3,047,019,908

Operating expenses, as assigned to the five general classes, were as shown in Table 4.

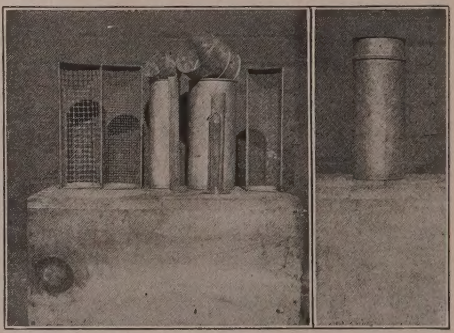
TABLE 4—OPERATING EXPENSES

Maintenance of way and structures	$419,277,779
Maintenance of equipment	532,138,606
Traffic expenses	63,769,677
Transportation expenses	1,101,597,432
General expenses	83,529,665
Total operating expenses	$2,200,313,159

With minor eliminations from the figures given above, operating revenues per mile of line operated (including line operated under trackage rights) averaged $12,400 and operating expenses $8955 for the year.

Portable Screening Outfit Aids Sand Tests on Road Work

NO single feature of the problem of constructing roads in the State of New York is regarded as of greater importance than the testing of sand for use in concrete. The State Highway Department is equipping its field engineers with the portable outfit shown in the accompanying photograph. It was developed originally on work of the Illinois Highway Commission. The apparatus consists of semi-circular screens, a small galvanized tube, a scale, a graduated glass for measuring the amount of loam. The whole outfit is contained in a tube with a cover, shown in the picture at the right. The screens fit into each other, the smaller tube occupying the space within the last screen. The graduated scale is for the measurement of the volume of sand in the tube. The outfit may be packed up and carried readily about the work. A particular effort is being made by the State Highway Department to impress upon the men in the field the danger of using sand aggregate unless it has been subjected to proper tests.



COMPACT PORTABLE OUTFIT FOR SCREENING TESTS OF SAND—TUBE AT RIGHT CONTAINS ALL EQUIPMENT IN LEFT HAND VIEW

Chief Engineers Discuss Grade-Crossing Law and Cost Distribution

Agree as to Importance of Subject and Fairness of Public Participation in Expense — One Doubts Desirability of Uniform Law

A NUMBER of railroad chief engineers and other officials experienced in grade-crossing problems were asked to comment on the article "Grade-Crossing Law and Its Effect on Grade-Crossing Elimination." Discussions are here presented from E. H. Lee, vice-president and chief engineer of the Chicago & Western Indiana Railroad; W. H. Courtenay, chief engineer of the Louisville & Nashville Railroad; F. B. Freeman, chief engineer of the Boston & Albany Railroad, and J. L. Campbell, engineer maintenance of way of the El Paso & Southeastern system. All agree that the subject is of much importance, and there is no dispute as to the fairness of public participation in the expense of grade-crossing elimination. Two of the four agree with the conclusions in the original article that a uniform law and a fixed percentage basis are desirable. A third doubts this, while the fourth is non-committal as to details, although convinced of the need of co-operation and a division of the expense.

The discussions follow:

Mr. Lee Indorses Original Conclusions—Cites Readiness of Cities to Demand Much When Railroads Bear Bulk of Expense

The article on "Grade-Crossing Law and Its Effect on Grade-Crossing Elimination" is a timely discussion of an exceedingly important subject. The conclusions reached appeal to me as sound and logical.

The elimination of grade crossings before the work is needed, and the construction of subways where relatively superfluous, both involve a large economic waste. As pointed out in the article, probably the best way of avoiding this waste is to secure the adoption of a plan under which the public will directly bear a fair share of the expense.

The average man is apt to be indifferent to expenditures, no matter how extravagant, which cost him nothing, or which he thinks cost him nothing. He is coming to see, however, that the lack of reasonable prosperity for the railroads is a large factor in general business depression, and therefore how it directly touches his pocketbook. If the city, county and State assume a fair share of the cost of grade-crossing elimination, it will largely reduce the demands made and the expenditure for needless improvements of this character, and I think that it should be practicable to show our average man that such needless and wasteful expenditures by the railroads interfere with their prosperity, and therefore interfere with his own prosperity.

EXTRAVAGANT TRACK ELEVATION

In Chicago the expenditures to date by the railroad companies for track elevation are upward of $80,000,000, while the city, which agreed to assume certain abutting land damages, has spent less than 1 per cent of that amount. Tracks have been elevated here under police power of the city. It is unquestionably true that the city has required the elevation of trackage within its limits, which might well have been deferred, because of the fact that it has borne relatively none of the expense. So, too, in many cases an excessive number of subways and work of other kinds have been required which are of little value to the public, and which have added materially to the total cost.

Now that grade-crossing elimination has been carried forward in so many cities, it seems certain that work of this character will be required with an increasing frequency. In fact, unless the various governmental organizations bear a fair share of the expense, it is difficult to see where extravagant grade-crossing elimination expenditures by the railroads are to end.

If the railroads will give this exceedingly important question the attention which it deserves, and will after mature consideration get together on a plan for a division of the expense which shall be fair to all parties, I am strongly of the opinion that they will be in a much better position than at present to secure the fair treatment from the public to which they are entitled. A policy of co-operation would certainly seem to be, in the long run, the best for all concerned.

Mr. Courtenay Deems No Law at All Better than Bad Law

Railroad managers realize fully the importance of this subject, and appreciate the difficulties involved more keenly than others, on account of their experience with problems of this character and knowledge of the conditions.

No grade-crossing law whatever is far better than a law requiring the separation of all highway and railway grades within a limited term of years, for the cost of eliminating all grade crossing in some States would doubtless exceed the cost of reproducing all of the railroad roadbeds in those States. No law, therefore, should be drawn without having some investigation made by a competent engineer of the probable expenditure involved.

MUNICIPALITY CAN BEST HANDLE LAND MATTERS

A reasonable approximation of the cost of any general scheme of grade separation is difficult of ascertainment, particularly on account of damages to abutting property. The amounts which owners may recover for real or alleged damage to their property due to change of level of street or roadway cannot be predicted. It depends largely on the skill of the attorney of the land owner in the event of the claim being carried to the courts. It is a common and well-founded belief among railroad engineers that amounts recovered for damage to abutting property will be less if the municipality, county or State, as the case may be, pays such damages, than if the railroad corporations are required to pay them. This knowledge furnishes support of the plan of requiring the public to pay the abutting damage, if any.

There is much to be said in favor of an arrangement by which the railroad corporation shall pay the cost of that part of the construction for grade separation on its own right of way or property, and the general public pay the remainder.

DOUBTS DESIRABILITY OF INFLEXIBLE LAW

As there is so wide a variation of conditions in different situations, it seems impracticable to determine a basis of division of expenditure which will be applicable to all grade-separation projects. The difficulties of getting a uniform grade-crossing law in all of the States are probably insuperable. No law at all on the subject is better than a bad law. If the matter is agitated, the probability of getting a bad law, and particularly one which is too inflexible in its terms, is greater than the probability of getting a good law, framed only after full and costly investigation and careful consideration of all elements of the many different problems which are likely to arise.

It is the writer's opinion that public welfare does not demand the passage of a law which will require the separation of grades at crossings of all public roads with railroads, and the passage of such a law, even on the basis of 50 per cent of the cost payable by railroad corporations, and the remainder by the public, if enforced, would result in more detriment than benefit on account of the heavy expenditure involved.

It would seem to be better to endeavor to secure the modification of existing laws pertaining to this subject which are inequitable, than to attempt to secure the passage of laws upon the subject in those States where laws touching the matter do not now exist.

Mr. Freeman Doubts Fairness of Making Railroad Pay Even 50 Per Cent

I have read the article on "Grade-Crossing Law and its Effect on Grade-Crossing Elimination," and quite agree that a uniform law would be very desirable. I also agree that when the subject is thoroughly analyzed, it is not a fair proposition to assess a steam railroad with more than 50 per cent of the cost of any elimination. It is somewhat questionable if, on the basis of the necessities of the parties interested, even 50 per cent on the railroads is completely justifiable.

A grade crossing interferes very much more with the business of a growing city or town than it does with the business of the railroad; in fact, the only instances where a grade crossing materially interferes with the operation of the railroad is where a slow order over the crossing is insisted upon by the municipality or town, so that it may be said that in eliminating grade crossings, the city or town undoubtedly gets very much the greater benefit out of the improvement, in the matter of reducing delays to its business. On the other hand, the necessarily large expense of the railroad work increases, very materially, the cost of the work.

The actual money saving to railroads is the elimination of maintenance of grade crossings and the maintenance of gate tenders and safety devices, and, also, the elimination of the risk of possible damages for persons or property injured at the crossing. On the other hand, the cities or towns, by the separation of the grades, remove the possibility of losing very valuable citizens, for which no payment in damages by the railroad could possibly compensate the city or town; particularly is this so in the case of young, growing cities.

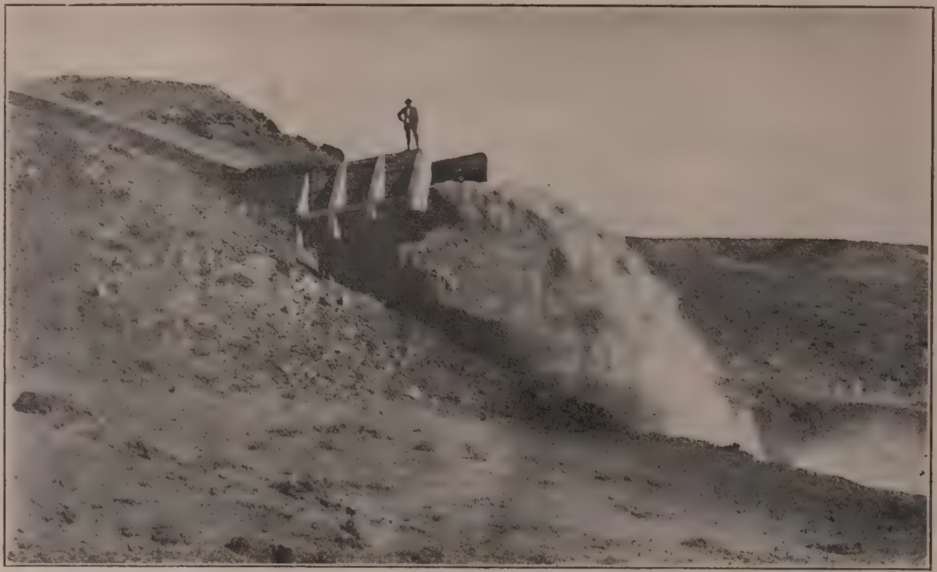
Looking at it from every point of view, I believe that a fair basis would be dividing the cost between railroads and other parties in interest on a 50 per cent basis, as suggested in the article.

Mr. Campbell Thinks Solution Lies in Educating Public to Realize Mutual Interests of Public and Railroads

One of the important things to be attained in progress toward a final equitable solution of the problem of grade crossings is a realization by the patrons of the railways, *i. e.*, the public, of the mutual interests and interdependence existing between them and the railways, and that they finally necessarily pay the total cost of the transportation service and do not escape the obligation and final settlement by temporarily throwing all the burden upon the railways.

The fairness of a division of expense between the railways and their patrons in elimination of existing grade crossings is apparent by remembering that the majority of such crossings are the result of the growth of the cities around the railways, the necessity for and the existence of perhaps a majority of such crossings not being a fact when the railways were originally built. Such crossings have come into existence, not because of any necessity of the railways, but because they were needed for the street traffic of the patrons of the railways. There are, of course, many exceptions to this, but such condition is generally prevalent and it is a fair and adequate illustration of the mutual interest and interdependence which, if fully realized and admitted, will do much to bring about that spirit of conciliation and co-operation so desirable to the best solution of so important a matter.

[The Engineering Record hopes that others who have been intending to comment on this subject will not be deterred by the publication of the foregoing discussions. A number of the points considered in the original article have not been touched upon, and it is hoped that the light of experience will be thrown on them. It is desirable, also, that the public as well as the railroad point of view be presented. —EDITOR.]



OVERHANG AT END OF CHUTE DISCHARGING 250 SEC.-FT.—CAPACITY, 1000 SEC.-FT.

Concrete Chute Drops Water 130 Feet from Canal to Reservoir

Curious Phenomena of Disappearance of Back-Water Wave When Chute Begins to Operate Normally

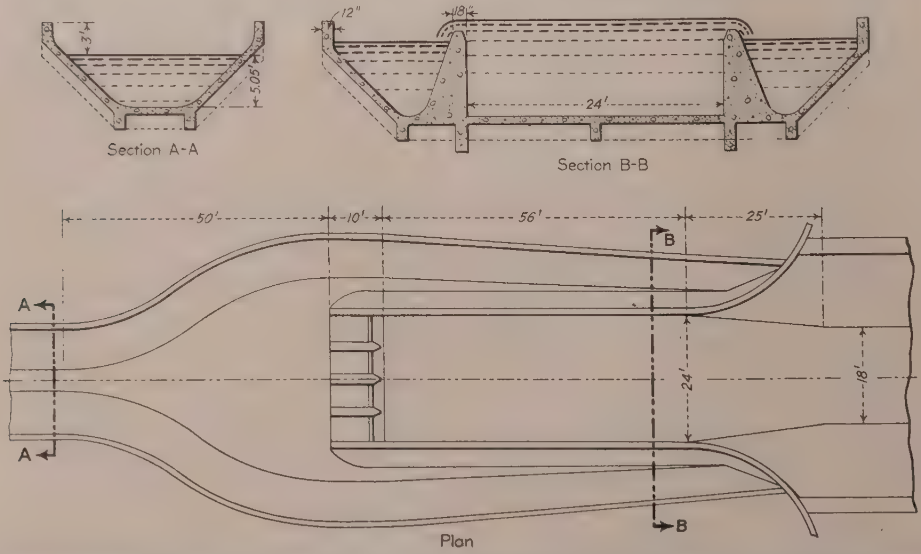
By D. W. COLE
Project Manager, Truckee-Carson Project, Fallon, Nevada

THE Truckee main canal 31 miles long terminates in the left bank of Carson River immediately above Lahontan Dam, the water surface of full canal being about 130 ft. above the bed of the Carson River and about 20 ft. above full reservoir level. In passing from the canal to the reservoir it is required to carry the water over the sand and gravel slopes and discharge it into the reservoir at all stages of the water level therein without erosion or other damage. For this purpose the type of structure adopted was a concrete chute or lined channel with a long weir at the head to regulate the water level in the main canal within the desired limits.

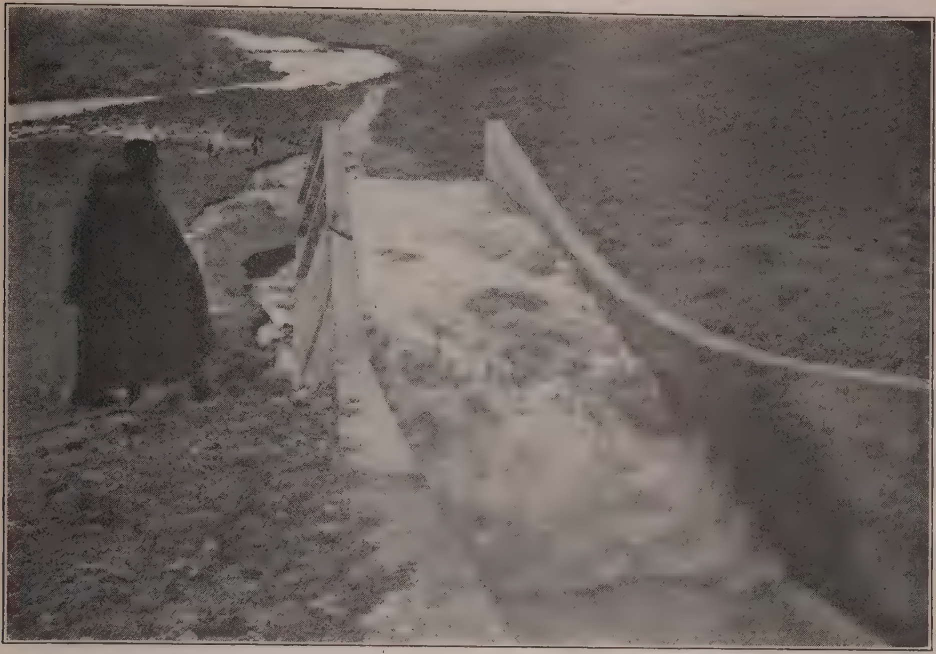
SECTION OF CANAL AND CHUTE

The structure as built includes an approach section, 300 ft. long, of cement-lined canal leading into a long rectangular forebay with a weir along both sides thereof and with four sluices each 5 ft. wide controlled by flashboards across the end. The total length of weir and flashboards is 141 ft. The discharge over the weir falls on either side into a tail-race channel paralleling the weir; these two channels converge into a funnel-shaped section at the head of the chute. From this point the chute is in the form of a channel which may be described as an ordinary canal section with flat bottom and one to one slopes modified by having the angle between the bottom and sides rounded by a curve with the upper portion of the slopes curving into a vertical face at the top. This section continues for 210 ft. where it begins to transform by warping through a length of 74 ft. into the rectangular section 10 ft. in width and about 6 ft. deep which continues for 357 ft. and then changes to the final width of 9 ft. in the last 40 ft. of its length. The end is

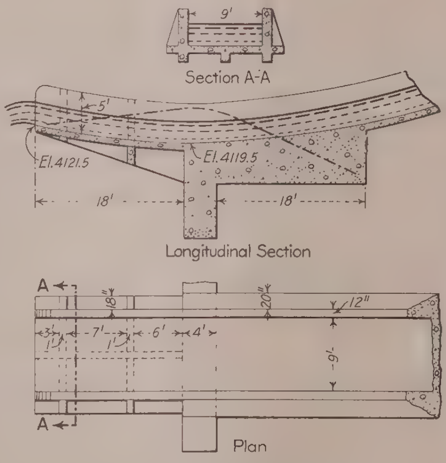
COMPLETED CANTILEVER UPTURN AT DISCHARGE END OF CHUTE



THE DISCHARGE OVER THE WEIR FALLS ON EITHER SIDE INTO TAIL-RACE CHANNELS PARALLELING THE WEIR AND CONVERGING INTO A FUNNEL-SHAPED SECTION



WATER HELD IN POCKET AT LOWER END OF CHUTE CARRYING ONLY 80 SEC.-FT.



DETAILS OF DISCHARGE END

built as a cantilever overhanging for 18 ft. and strongly anchored to a heavy concrete block in the foundation.

The total length of structure is 1122 ft., with 681 ft. in the chute proper. The total drop in the structure is 52 ft. and the balance of the drop occurs below the chute where (with the reservoir empty) the water is discharged through the parabola due to a velocity of 34 ft. per second and falls on to the soft rock and clay bottom which has been eroded to form a deep pool, thus making a water cushion which prevents further erosion.

OPERATION OF CHUTE

It will be observed that with the reservoir at its higher levels the lower end of the chute will be submerged and the inflowing canal water will strike the reservoir water with considerable velocity which will cause waves in the vicinity of the impingement. This is provided for by heavily riprapping the sandy and gravelly slopes surrounding the chute. The cantilever terminus of the chute is founded upon a fairly good rock bottom and the throw of the water beyond this will obviate undermining at low reservoir levels.

The up-turn of the cantilever terminus amounts to 2 ft. from the low point of the vertical curve to the end of the nozzle, so that the issuing stream of water is thrown upward and well forward, the water finally striking bottom at a distance of 50 ft. or more from the end of the chute, according to the volume carried.

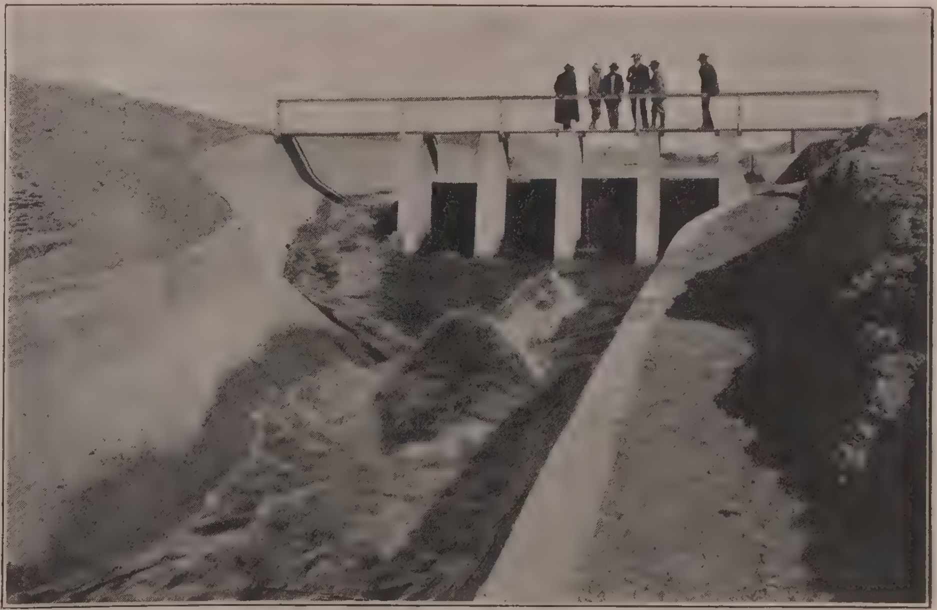
Thus far there has been occasion to operate the chute at only about half its rated capacity and under these conditions it has given good satisfaction, with promise of equally good results at full discharge.

BACK-WATER WAVE

In this connection an interesting hydraulic phenomenon was observed at the time when the chute was first put into service. When water was first turned into the chute the flow was slowly increased from a minimum, and for some time the water was pocketed in the depression at the bottom of the vertical curve in the cantilever section, while the issuing stream fell vertically downward instead of taking the parabolic path of discharge. This continued up to a flow of from 80 to 90 sec.-ft., when the back-water wave, in a very turbulent state, built up nearly to the top of the side walls, which are of uniform height throughout, and the observers began to fear that the water would slop over the sides at the low points before it would shoot out and take the form of discharge which had been calculated for it. Before increasing the flow the experimenters took the precaution to pile sand bags on top of the side walls at the low point; but with increasing flow and at just about the time when the water began to slop against the sand bags it very suddenly and like a thing alive shot out from the end of the chute in the prescribed parabolic path, the back-water wave disappearing almost instantly and the stream adjusting itself to a uniform depth throughout the vertical curve. This curious and interesting demonstration in hydraulics is partly shown by the photographs, but as observed at the time the performance was quite sensational and almost startling in its definite vindication of mechanical law. Upon each occasion when the chute is put into operation this phenomenon recurs and it is interesting to observe that while the back-water wave persists until the increasing flow reaches about 90 sec.-ft., it does not reform with decreasing flow until this falls to about 40 sec.-ft.

Following Explosion, Boston Sewer Tests Show No Gasoline

FIRE prevention commissioner John A. O'Keefe of the Boston, Mass., metropolitan district has received a report from Arthur D. Little, Inc., chemists and engineers, Boston, stating that tests on Feb. 24 in East Boston, Revere and Chelsea indicate that no appreciable amount of gasoline or its vapors was present in the sewers at ten manholes between 1 and 4.30 p. m. The manholes from which samples were taken were for the most part those where explosive mixtures were obtained in June, 1914, following the East Boston pumping station explosion (see Engineering Record, Nov. 21, 1914, page 555, and Dec. 5, 1914, page 606). The samples of sewer air taken were tested at once for the presence of inflammable vapors, and none showed explosive character or



WAVE OF CONFLUENCE AT CENTER WHEN DISCHARGING 200 SEC.-FT.

gave the odor of either gasoline or benzol. The tests indicate that either through the publicity campaign, the installation of separators, or otherwise, the practice of emptying gasoline into the sewers has been much reduced.

Test Apparatus

The apparatus used in the tests by the Little staff was based upon that of Prof. A. L. Dean of Yale University for similar service, but differed from his equipment in certain particulars, rendering it more suitable to outdoor use. The object was to provide an apparatus with which a gas sample can be taken and tested in the field instead of requiring return to the laboratory for test, which enables the investigator to make many more tests in a day and at reduced expense. It consists essentially of a long rubber sampling tube and aspirator connected to the inlet cock of a priming spark plug of the automobile type. The sample was taken in a rubber balloon which was first collapsed and slipped over the end of the spark plug, due precautions being taken to purge out the pipe and see that the sample is representative and taken from a point close to the liquid in the sewer.

Just as soon as the balloon is inflated with the sample, a spark is established at the terminals of the plug and if gasoline vapor is present in any amount from about 1.1 per cent up to a mixture too rich to explode, it will manifest itself by a sharp explosion bursting the rubber container. Experiments with artificially made mixtures show that this will work with entire reliability.

Interpreting the Tests

If after testing several samples no explosion is obtained, it may be regarded as certain that there is not so much as 1.1 per cent of gasoline vapor present. To guard against the possibility of too rich a mixture for explosion a part of the mixture was discharged at particularly suspected points and refilled with air, thus diluting the remaining quantity. Had the failure to explode been due to the presence of excessive gasoline, this procedure would have brought about an explosion of the balloon.

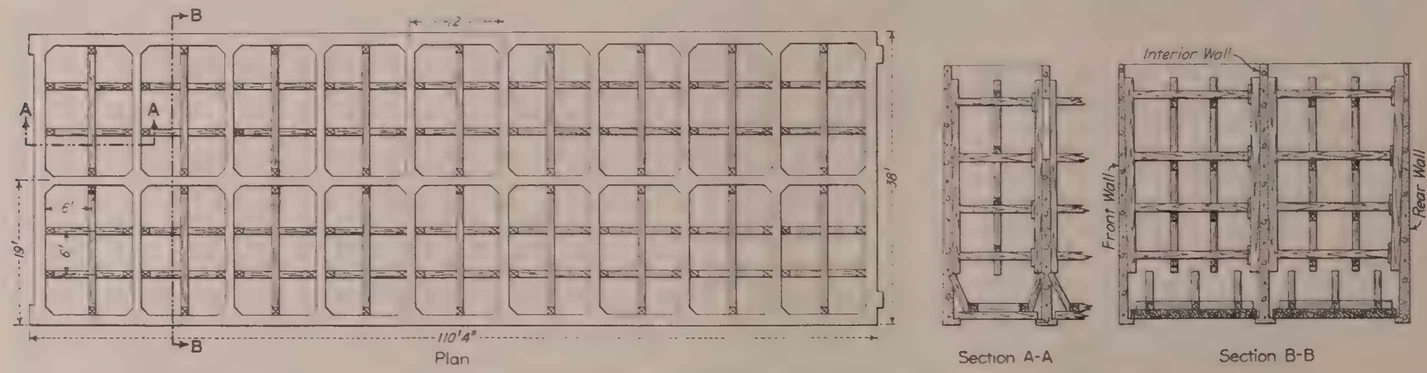
The apparatus is capable of development into a compact portable set for quick tests, and a set of this character will shortly be assembled. This will be of value to the department of fire prevention as a means of making quick tests without return to the laboratory. In employing it, precautions are always taken not to explode the rubber gas container at a point where if gasoline were present the flame would be communicated to the sewer.

Large Reinforced-Concrete Cribs Used for Welland Ship Canal Entrance

Sections 38 x 110 Feet in Plan and 34 Feet High with Removable Bottoms Are Built in Pontoons and Placed on Windrows of Broken Stone

By REX P. JOHNSON
Assistant Engineer, Welland Ship Canal

Reinforced-concrete cribs of unusual size, built in pontoons, floated into position, and placed upon windrows of broken stone, form the entrance walls for the Welland ship canal and its Ontario harbor. The total length of each crib is 110 ft. 4 in., the width 38 ft., and depth 34 ft. The pontoon is built in knock-down form, so that when the crib is finished and the temporary wooden bottoms placed, it can be floated away. After floating the crib into position so that the longitudinal walls rest upon carefully-placed rows of broken stone, the temporary bottoms are removed, and the inside filled with materials dredged from the channel. Careful analysis was made for the various possible conditions of pressure on the walls, and economy in the use of reinforcement attained by using timber bracing to decrease the bending moments due to temporary high pressures during construction.



GENERAL DIMENSIONS OF CRIB AND POCKETS, AND DETAILS OF METHOD OF USING TIMBER BRACING

The harbor which is now under construction at Port Weller forms the northern or Lake Ontario entrance to the canal, which is being built across the Niagara Peninsula. The harbor is being formed by building two parallel earth embankments from the original shore line for a distance of one mile and a half into the lake and dredging between them. These embankments will be protected by rough rip-rap for the greater portion of their length, but there are portions which are to be sustained on the inside with reinforced-concrete cribs. These will provide vertical faces for the mooring of ships and, at the outer end where the embankments converge, will give a navigating channel for the full width between embankments. The total number of cribs to be built is fifty-three.

General Features of Construction

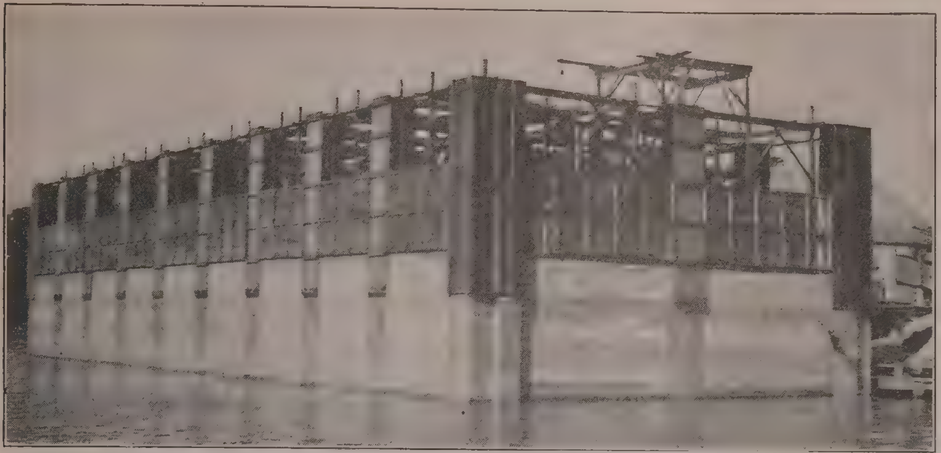
The method of construction is to build the cribs in a floating pontoon in Port Dalhousie harbor, some three miles distant from the site of their final location, and then to tow each one into position and sink it on a seat prepared by dredging. Each crib is divided into eighteen compartments or pockets by means of one longitudinal center wall and eight cross walls. The outside end and longitudinal walls extend from top to bottom without an opening of any description, while the interior walls have a rectangular opening 8 ft. x 14 ft., the bottom of which is 12 ft. from the top of the crib. The purpose of these openings is to reduce the weight of the crib and, since they are near the top, to bring the center of gravity lower down. Thus each pocket is separated from those adjoining for a depth of 22 ft., and it is intended that each shall be watertight. Watertightness is important, since the crib is required to float during construction and possibly for some considerable time after it is built.

A feature of the complete separation of the lower portion of the pockets is that, in the event of a leak developing in some part of the structure, only one or two pockets are flooded and the crib, instead of sinking, merely heels over somewhat from the vertical. The openings just mentioned in the interior walls do not extend down far enough to allow water to flow from a flooded pocket to a neighboring dry one except during sinking. Each pocket has a temporary timber floor or bottom which is wedged in place in such a way that, after the crib is sunk, the wedges are pulled out by chains attached to them and extending to the top of the crib. The patents for these bottoms are held by Messrs. J. L. Weller, engineer-in-charge, and F. E. Sterns, designing engineer, Welland ship canal.

Sinking and Filling Cribs

The sinking will be accomplished by pumping water into the pockets or by means of sea cocks in the outer walls. By carefully admitting the water the crib can be brought to within a few inches of the bottom and, when brought into exact position and line, a little more water admitted will bring it to rest in position. If, for any reason, it gets out of line while sinking the last few inches, some of the water can be pumped out and the crib will float again, thus allowing the error to be corrected. Each crib is provided with vertical projecting ribs at opposite ends and arranged in such a way that the crib will be keyed to the two adjoining ones.

The seat for each crib is dredged to a little below the required grade and then, to insure an even bottom, three windrows of broken stone are placed by means of spouts and levelled off, so that one windrow comes directly under each of the front, center and rear longitudinal walls of the



WEIGHT OF CRIB SUBMERGES PONTOON AS CONSTRUCTION PROCEEDS

crib. After the crib is in its final position the temporary bottoms are removed. The pockets of the sunken crib are to be filled by dredges with selected excavation (not rock) from the harbor. The reasons for constructing a crib with bottomless pockets are for economy, since the timber bottoms can be used over and over again, and for the purpose of allowing the crib filling to rest upon the sea bottom instead of on the bottom of the crib as is ordinarily the case. This tends to prevent settlement and prevents undue strains upon the crib and secures an even bearing on the foundation, accomplished by means of the rows of stone under the longitudinal walls.

CRIBS BUILT IN PONTOONS

Each crib is built in a pontoon, which is nothing more than a rectangular box with open top and having for its inside dimensions those of the outside of the crib. The depth of the pontoon is about 9 ft., and it is built in knock-down form so that, when the crib is finished and the temporary wooden bottoms placed, it can be taken off. This is done by unscrewing the sides and ends and allowing them to float away, and allowing the bottom, which has been previously ballasted, to sink away. Inside the floating pontoon are built the forms for the lower portions of the walls, the sides of the pontoon acting as a part of the form work. As the walls rise, the pontoon sinks deeper and deeper and finally disappears below the surface owing to the continually increasing weight sustained by it, the sides of the crib above the pontoon serving to keep the water out. The temporary bottoms are placed after the form work in the pockets has been removed.

A watertight joint is made between the bottoms and the concrete ledge upon which it rests by placing between them a rope made of jute yarn covered with canvas, which is tightly squeezed down by the wedges that serve to hold the bottom in place. On the construction work which has already been accomplished the contractors have poured the concrete in lifts of about 3 ft., alternately placing the horizontal reinforcing steel in position for each lift and pouring concrete. The vertical steel extending from top to bottom without a break must be placed before any concrete is poured. The accompanying photograph shows a partially completed crib, the pontoon having become submerged.

CONDITIONS GOVERNING DESIGN

The design takes into account three different conditions of loading for the walls: (1) The exterior water loads on the floating crib; (2) the exterior and interior water loads on the sinking crib, and (3) the interior fill loads on the submerged crib when it is in its final position and during filling.

First, the exterior water load on the floating crib will be considered. The position of the water line on the completed crib is determined by considering its displacement, and then it is assumed that one or more of the pockets may become partially or wholly flooded to such an extent that a maximum heeling over is produced which causes the water line to rise on one side a distance of 5 ft. The maximum head of water sustained by any one wall is found to be 18 ft. for this condition, and the pressure diagram can be drawn. This load may occur on the interior walls as well as on the exterior, since any one pocket may become flooded.

Next, consider the water loads on the crib as it sinks. When the water is admitted to the crib it starts to sink, thus causing the water line on the outside to rise. This reaches the top of the crib when the water on the inside is 14 ft. from the top and the resulting pressure diagrams are as shown. The interior walls, as well as the exterior, are designed to sustain this load, since any one of the pockets may become wholly flooded before the crib is ready to sink.

Finally, the pressures set up on the walls by the fill loads will be considered. When in actual service the top of the crib is to come at mean lake level and on top of the outside longitudinal wall a 7-ft. retaining wall will be constructed to support the back filling. This fill is for the purpose of bringing the pier up to final grade and, of course, acts as a superimposed load on the front longitudinal wall of the crib. We then have the condition of a dry fill 7 ft. deep, and under this a thoroughly saturated, or, strictly speaking in this case, a submerged fill contained in a pocket or box-like structure having the walls comparatively close together, and hence a condition somewhat similar to that in the bins of a grain elevator. The pressures on the front wall due to the fill are greater than for the interior and rear walls, because the filling operation will be regulated so that no one pocket is filled to the top before the adjacent ones are at least half filled. This point is taken up again later.

PRESSURE DIAGRAMS

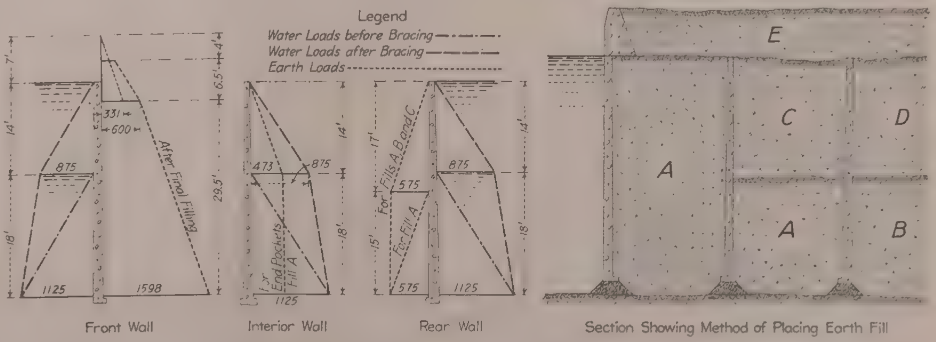
The pressure lines resulting from the foregoing conditions are shown on the accompanying figure. The following assumptions are made with regard to the fill: (1) The fill above the water is dry, weighs 110 lb. per cubic foot and has a slope of repose of $1\frac{1}{2}$:1; and (2) the fill below the water is thoroughly saturated and has a slope of repose of 3:1. Its weight when dry is 110 lb. per cubic foot, if free from voids it would be 153 lb., and therefore when immersed it weight $110 - (62.5 \times 110/153) = 110 - 45 = 65$ lb. per cubic foot. (See American Civil Engineer's Pocket Book, page 580.)

At the water line, i.e., at the top of the crib, there is a horizontal pressure due to 7 ft. of dry fill having a slope of repose of $1\frac{1}{2}$:1. Below the water line the pressures on the walls are due to a submerged fill with a slope of repose of 3:1, and they are complicated somewhat by the proximity of neighboring walls. The effect of nearby walls on earth pressures is very little understood. It is probable that the total pressure on any one wall is less than it is for an ordinary retaining wall sustaining the same material. In the calculation for the crib no reduction has been made on account of these walls.

The diagram for the earth load on the front wall is calculated by Coulomb's formula for earth pressures for two conditions: (1) When the harbor is at high water and the depth of dry fill is only 4 ft.; and (2) when the harbor is at low water, and the depth of dry fill is 10.5 ft. The resulting pressures are shown by the accompanying diagrams.

PRESSURES ON INTERIOR WALLS

The sectional elevation drawn with the diagrams herewith shows the order in which the pockets are to be filled with earth. The two fills marked A are to be made simultaneously, then B, then two fills C simultaneously, then D and E in order. Thus we get an earth load on the center longitudinal wall which is partially balanced over its lower portion, and on the rear wall we get an earth load over the lower half



Front Wall Interior Wall Rear Wall Section Showing Method of Placing Earth Fill

DIAGRAMS SHOWING CONDITIONS OF EARTH FILL AND WATER PRESSURE and later over its whole height, but with the lower portion reduced by the fill B. By adopting this method of filling a considerable saving can be made in the reinforcing steel for the walls. The earth pressures on the interior cross walls are the same as for those on the center longitudinal wall. The earth load diagram shown for the interior wall occurs only in the end pockets. In all the others the load is less because the openings in the interior walls allow the filling to flow through from one pocket to another before any one of them is filled to the top.

A comparative study of the combined pressure diagrams reveals the large loads carried by the walls due to the water pressure when the crib is sinking. These act for a comparatively short interval of time, and it seemed that if some scheme could be devised for bracing the walls while the crib is sinking that a very considerable saving in reinforcing steel could be effected.

USE OF TIMBER BRACING

The scheme proposed is to use timber bracing wedged into the pockets. It is placed before admitting water and removed before the pockets are filled with earth. The bracing is arranged in such a way that the spans over which the water loads act are reduced to 6 ft., and hence the bending moment, and therefore the steel necessary, are considerably reduced. The drawing on page 458 shows the proposed arrangement of the bracing. It is seen that without this bracing the spans of the front, rear and center longitudinal walls are 12 ft., and of the end and cross walls 18 ft. When it is remembered that the bending moment varies directly as the product of the square of the span and the load per unit of span, the effect of the bracing in reducing the quantity of reinforcing steel is apparent.

The walls are designed as slabs, using the load diagrams to give values of loads per foot. For permanent loads the stresses for steel and concrete and the coefficients for bending moments are those recommended by the Joint Committee on Reinforced Concrete; but for temporary loads, or loads which act only for a short time, such as in the sinking operation, the stress in the steel is run up as high as 25,000 lbs. per square inch. Longitudinal stiffness is given to the crib by placing reinforcing rods near the top of longitudinal walls for their full length. The reinforcing steel is in the form of plain round rods, and the spacing has been confined to multiples of 6 in. as some little aid in standardization and simplicity in construction. For the same reason the size of rods is confined to ¾ and ⅞-in. diameters. Each crib requires 934 cu. yd. of concrete and 112,000 lb. of steel.

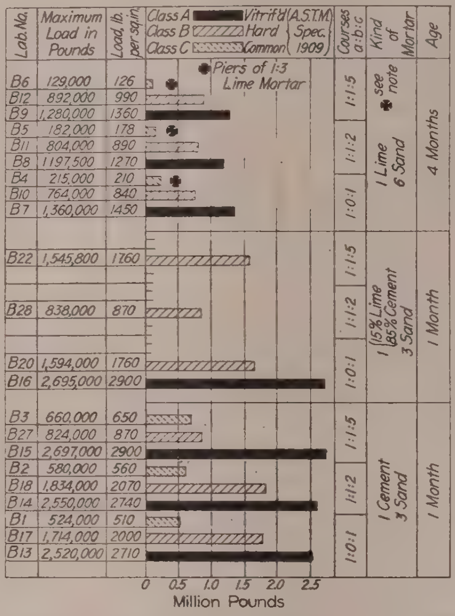
The work is being done under the direction of the Department of Railways and Canals of the Dominion Government. J. L. Weller is the engineer-in-charge.

ERRORS IN BIDDING in omitting to charge a portion of the work may not be corrected after acceptance of the bid, according to a decision recently rendered by the U. S. Court of Claims. The court also held, in the same case, that liquidated damages deducted by the Government in the sum of $1457.70 would not be interfered with, when the facts showed that more than $1200 was actually spent by the Government on account of the delay of the contractor in completing the work.

Large Brick Piers Tested at Laboratory of Bureau of Standards

Strength Is Directly Affected by Kind of Brick and Quality of Mortar, but Not by Various Methods of Course Bonding

MOST of the tests heretofore made upon brick piers have been restricted to sections of relatively small dimensions. Inasmuch as construction of this kind is necessarily non-homogeneous and its strength is directly affected by the dimensions of the test specimen, tests upon brick piers of a size commensurate with modern engineering practice were instituted by the National Brick Manufacturers' Association. The committee on technical investigations, of which Prof. Edward Orton is chairman, planned a series of tests with the object of ascertaining the general effects of kinds of brick, quality of mortar and methods of course bonding. The general laws of resistance to vertical pressure were also sought, although the series could not be made sufficiently complete to fix more than the general trend of effects of a few factors.



RELATIVE ULTIMATE STRENGTH OF LARGE BRICK PIERS

These tests have been conducted in the Engineering Physics Laboratory of the Bureau of Standards at Pittsburgh. The results are contained in a progress report written by J. H. Griffith, associate engineer-physicist, and J. G. Bragg, assistant physicist of the laboratory, and read at the meeting of the National Brick Manufacturers' Association held Feb. 16-19 at Detroit. Parts of this report are here abstracted and published by permission of the director of the Bureau of Standards.

PROGRAM AND DESCRIPTION OF TESTS

The program outlined by the committee includes the testing of piers made with brick from four districts—New York and vicinity, Pittsburgh and surrounding sections, Chicago and Galesburg, Ill., and Atlanta, Birmingham and New Orleans. Three classes of brick were used—class A (vitrified), class B (hard) and class C (common)—classified according to the report of Committee C-3, "Proceedings" of the American Society for Testing Materials, Vol. XIII, 1913.

Mortar of three kinds was used, as the importance of this variable was recognized, and comparative results were desired. The mixes were by weight as follows:

1:3 Portland cement and sand.
1:3 Combination (85 per cent cement and 15 per cent lime) and sand.
1:6 Lime and sand.

The construction of the piers, which were all 30 in. square (as nearly as possible) and 10 ft. long, was varied by three types of bond, using (1) every other course a header, (2) every fourth course a header and (3) every seventh course a header.

Tests were conducted in the usual manner for such specimens, an adjustable platform at the bottom carrying the pier, which was constructed on a steel bedplate, and a plaster-of-Paris bearing cushion provided at the top. Full-length rods with Ames dials attached were connected to steel bars embedded in the first and last joints at the corners. In addition, numerous readings to determine local and lateral strains were taken, principally near the mid-height of the piers.

The accompanying photographs indicate clearly the characteristic types of failure, showing the lateral bulging and vertical cracks or laminations. The diagram gives the ultimate strength for the different classes, and indicates graphically the comparative results. All cement-mortar piers were tested at the age of one month, and the lime-mortar piers at the age of four months.

The conclusions, given in full, indicate the results of the work to date. They contain a summary of an interesting discussion of the causes of failure, which is too lengthy to be included here. Strain-gage measurements taken in the horizontal joints and in the center of adjacent courses indicated no greater average elongation for the joints, disproving the theory that the "spread" or lateral progression of the mortar tends to cause the scaling or splitting of brick. Two 5-ft. piers with horizontal wire reinforcement were also tested, and an increase in strength of 31 per cent resulted for the pier with reinforcing in every joint, while it was demonstrated that a decrease of 15 per cent occurred when every fourth joint was reinforced.

SUMMARY OF CONCLUSIONS

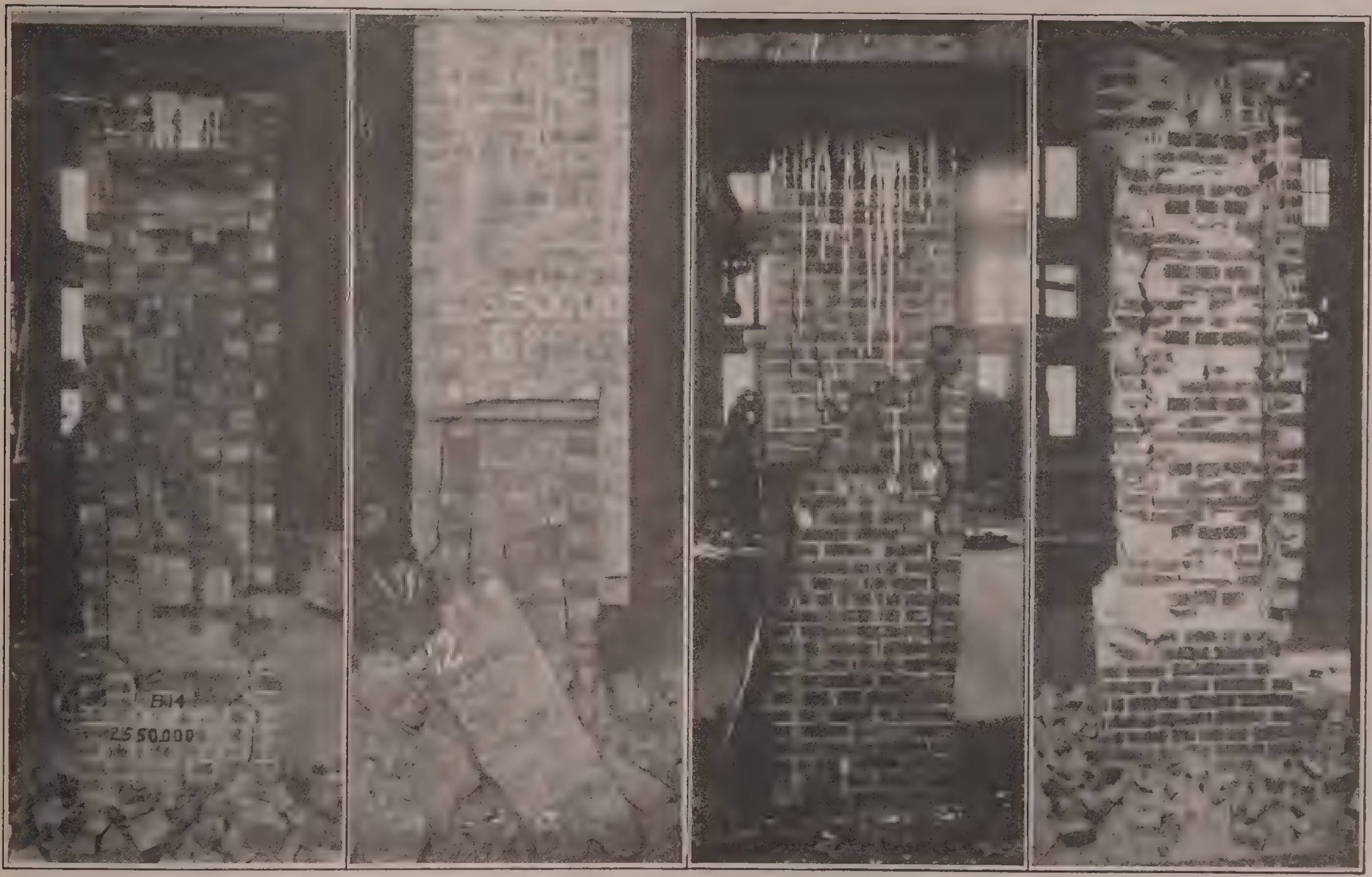
The following is a summary of the main points of the investigation:

1. The strength of large piers under vertical loading in common with smaller piers bears a close relation to the kind of brick used and the quality and age of mortar. The specimens laid in the cement (1 : 3) and the cement and lime mortars have, practically speaking, an equivalent strength for any one grade of brick. The relative strength of piers of A, B and C specification brick laid in these mortars is approximately in the ratio of 5 : 3 : 1.

The ratio of the maximum unit loads of the piers laid in the above mortars compared with those laid in the 1 : 6 lime mortar is about 2 : 1 for the A, B, and C grades respectively, this ratio being still larger (about 4 : 1) in the case of C specification brick laid in 1 : 3 mortar.

2. The low strength of piers laid in the lime mortars is attributed in the main to insufficient aging with a consequent lack of proper carbonation of the mortars, but it is doubtful whether this condition would be approached even after many years in an actual structure.

3. The experiments thus far conducted seem to indicate that the strength of a pier is largely independent of the course bonding, the real function of bond being, it is believed, to maintain a certain integrity and monolithic action of the masonry against initial strains induced through setting and "drying out" of the mortar, rather than any great increase of vertical strength due to the bonding.



B14—Class A, 1:3 Cement B2—Class C, 1:3 Cement B27—Class B, 1:3 Cement B8—Class A, 1:6 Lime

TYPICAL LAMINATED APPEARANCE OF FOUR OF THE LARGE BRICK PIERS TESTED TO FAILURE

The slight increase of strength with the increase of distance between header courses is thought to be inconclusive on account of a probable reduction in the effective resistance of the bonding courses chosen, due to the presence of too many fractional brick.

4. The mean moduli of the piers of A and B specification brick laid in cement mortar are 3,000,000 and 2,500,000 lb. respectively, the corresponding figures for piers in the lime and cement mortar being somewhat lower.

5. The "elastic limits" of the piers in the cement and cement-and-lime mortar is approximately one-half the maximum load.

6. Piers fail through a tendency to separate into vertical laminæ, caused by transversal failure in the individual brick, this occurring from flexural action produced through unequal distribution of the vertical load over the cross-section, together with ineffective shearing and adhesive strength of the mortar. Uniformity in the brick dimensions is also a factor to a lesser extent in reducing unequal compressions of the joint, as is the thickness of joint itself.

7. A high modulus of rupture is more desirable than superior crushing strength, as far as these can be differentiated in their interrelations. A higher modulus of rupture would be realized in practice either by increasing the thickness of the bricks or by laying them on edge so as to give their greatest flexural efficiency. (See report of Watertown Arsenal "Tests of Metals" 1884, page 80, for tests made when brick are laid edgewise, also some comparisons in paper by J. E. Howard, Engineering Record, March 22, 1913, page 333.)

8. A further study of the action of steel-mesh reinforcing is recommended in order to ascertain the load efficiency of piers having an outer shell of hard brick with an inner core of softer brick in the case of districts which are unfavorably located for the production of the higher grades of brick.

A RECORD SNOWFALL for April in New York City occurred on Saturday, April 3, when approximately 10 in. were deposited. The first flakes were noticed at 8.35 a. m. and continued all day. The U. S. Weather Bureau records, which as yet have not been fully tabulated, indicate a fall of 9 in. up to 8 p. m. and it is estimated that about 1 in. more descended after that time. The old record for April was 5.5 in., established on the ninth day of the month in 1907. The storm threatened to cripple traffic in the city streets, but the emergency snow-fighting force was called out by John T. Fetherston, commissioner of street cleaning, and by Sunday morning the streets were partially cleared.

First Section of Sacramento Trunk Sewer Completed

Municipal Sewage Pumping Plant Calls for 8000 Feet of 9½-Foot Sewer, of Which 2200 Feet Have Been Finished

A MUNICIPAL sewage pumping plant is under construction at Sacramento, Cal., and a 2200-ft. section of the 9½-ft. trunk sewer it requires was recently completed and for two days was kept dry and held open to public inspection. The outfall is 4 ft. below the level of the Sacramento River, and a pump house built over the sewer 500 ft. back from the river bank provides pressure for overcoming the head of water on the outfall in the river. The outfall is provided with a 7½-ft. gate valve as a protection against river water flowing into the system in case of accident.

The pump house is equipped with three 36-in. and two 22-in. electrically driven Worthington sewage pumps with a total capacity of 144,000,000 gal. per day against the highest river stage. These pumps are driven respectively by three 350-hp and two 110-hp motors. Sewage approaching the pumping station will pass through a 9½-ft. sewer, flowing by gravity at a rate of about 2 ft. per second. After passing through the pumps it will be forced to the outfall through a 7½-ft. sewer at a rate of from 7 to 10 ft. per second. Both sections of the sewer are octagonal on the outside and circular inside. The sewer is built of reinforced concrete, the walls being 10 in. thick on top and bottom, 8 in. on the sides and 12 in. at the quarters. About 8000 ft. of the 9½-ft. section is to be built. Work was started last November and is to be finished before the end of 1915.

NEW SPAN, TURNED ACROSS RIVER, IS TOWED TO PERMANENT LOCATION

How the Chicago & North Western Railway Replaced Its Milwaukee Bridge

In Nine Hours Old Draw on Temporary Offset Location Was Floated Away and New Span Floated In and Put Into Service in Final Location

CLOCKLIKE precision, with a minimum of interruption to either railroad or river traffic, marked the finish, March 14, of the replacement of an old 500-ton double-track drawbridge and the movement of a new 800-ton superstructure into position on the new end piers and remodeled center pier of the old bridge of the Chicago & North Western Railway at Milwaukee. In order to permit the necessary reconstruction and remodeling of the old foundation, the old bridge had been lifted off its piers last October by means of scows, moved downstream about 60 ft. and placed on a temporary foundation, and the connecting tracks had been realigned.

The superstructure of the new bridge is of the center-and-rim-bearing type. The center bearing consists of a lower and an upper steel center casting, with a bearing chamber 30 in. in diameter in the top of the lower casting, containing a bronze disk working between two hardened steel disks. The upper casting is set directly on the upper steel disk. The rim bearing is of the usual type, consisting of rollers 15 in. in diameter working between upper and lower forged-steel treads, and is connected to the center by the usual radial and tangent rods.

The new superstructure, except the turntable, was erected on falsework in line with the old protection pier at its upstream end. This permitted the erection to be carried out close to the permanent location of the bridge, without interference with river traffic.

TURNTABLE

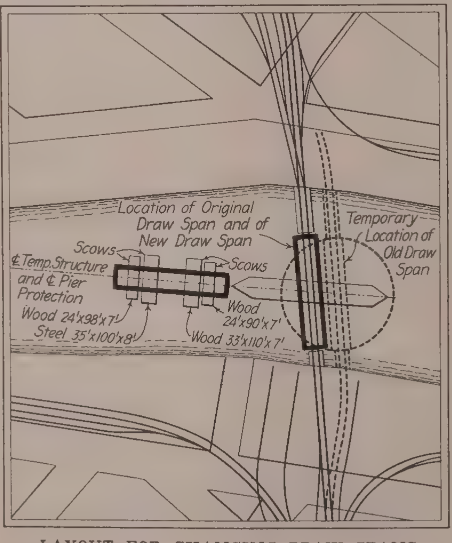
The turntable was erected in permanent position on the center pier. The upper steel disk was fastened to the upper casting of the center bearing with bolts with the heads countersunk in the lower side of the disk. This upper casting, with the attached disk, was assembled with the span on the falsework, as were also the upper tread castings with the upper treads attached. The material assembled in permanent position on the center pier therefore included all that part of the turntable below the upper treads and below the upper steel disk in the center bearing chamber, also the radial and tangent rods and the parts connecting them to the center casting.

About a month ago the work of remodeling the old center pier, constructing new end piers and erecting the new superstructure was completed. The last step, consummated on March 14, consisted in floating the new structure into position on the remodeled piers and removing the old temporary bridge.

THE LAST STAGE

Part of the falsework piling having been previously removed on Saturday afternoon, March 13, four large scows lowered to a specified depth in the water were floated under the new span, the blocking on their decks was adjusted and wedges were driven, bringing the span to bearing on the scows. The scows had been previously provided with 1 or 2 ft. of combing around the edges of the decks, so that the total displacement of the scow could be utilized for lifting, without submerging the deck. Inclined side bracing was placed on the two center scows to distribute the load of the span over their length. The bracing consisted of three 12 x 12-in. timbers extending to a point near the end of the scows. That night all preparations were completed for lifting the span on Sunday, March 14.

At 6.25 a.m. Sunday the pumps were started and the water was removed from the scows, raising them about 15 in. River traffic was closed at 7 a.m. At 7.15 a.m. the scows with their load were floated into the channel north of the falsework, and upstream far enough to permit the span to be turned square across the channel without touching the falsework. Care was taken to turn the span in the direction which would bring the connections of the power and signal installations on the superstructure into proper position with reference to submarine cable terminals on the center pier. All timber on the falsework was then removed down to the level of the tops of the caps, to make the way clear for the rack pinions, which projected down low and would be directly over the falsework as the span was floated toward the piers. The span was then floated downstream, straddling the falsework piling. It was anchored at 8.25 a.m. about 100 ft. from its permanent location, while the tugs were shifted to the task of moving the old span downstream.


Location of Original Draw Span and of New Draw Span
Temporary Location of Old Draw Span
Scows
Scows
℄ Temp. Structure and ℄ Pier Protection
Wood 24'x98'x7'
Steel 35'x100'x8'
Wood 24'x90'x7'
Wood 33'x110'x7'

LAYOUT FOR CHANGING DRAW SPANS

MOVING THE OLD SPAN OUT AND THE NEW SPAN IN

Four partly submerged scows having been previously floated under the old span and the blocking adjusted to give the lift desired, the wedges were driven under the span. Traffic over the bridge was closed at 10.18, after train 119, northbound, had passed. In about three-quarters of an hour sufficient water was pumped out of the scows to raise the old span about 1 ft. At 11.25 the old span was floated downstream about 100 ft., where it was anchored until it was convenient to float it to a selected landing place about 1 mi. away to await dismantlement. The tugs then returned to the new span, which was released and towed toward its piers.

The scows under the new span were held parallel to the protection pier until the northeast corner of the span was about 1 ft. from the west end of the north pier. Then the north end of the span was held stationary while the south end was swung until the bridge was parallel to its final position, guiding it by the ends and controlling the scows by ropes running to the drums of the hoisting engines on the scows. When the span had been brought to true alignment over the center pier it was held against any horizontal displacement by stop timbers at each end, and by ropes securing it firmly against wedges at the south pier.

The span was lowered until it was about 6 in. above its final position, and with the span at this elevation, the railway company's crew placed the centering ring on the center casting and centered the span accurately over the turntable. The centering ring was a steel band about 10 in. wide, of ¾-in. metal, made in three segments. The inside diameter of the band when the three segments were bolted up tight was the same as the outside diameters of the center bearing chamber and upper casting of the center bearing. This ring was placed around the bearing chamber on the pier, the bolts connecting the segments were loosened, and the ring was widened out to about 3 in. more than the diameter of the center casting. This allowed the upper casting to enter the ring without refined adjustment as the bridge was lowered.

When the bridge had been lowered to within 5 or 6 in. of its final position, the bolts connecting the segments of the centering ring were tightened, forcing the bridge into correct position over the center bearing. The lower edge of the upper bearing had been given a slight chamfer in the

NEW SPAN IN PLACE AND OLD SPAN (AT LEFT) BEING TOWED ASIDE

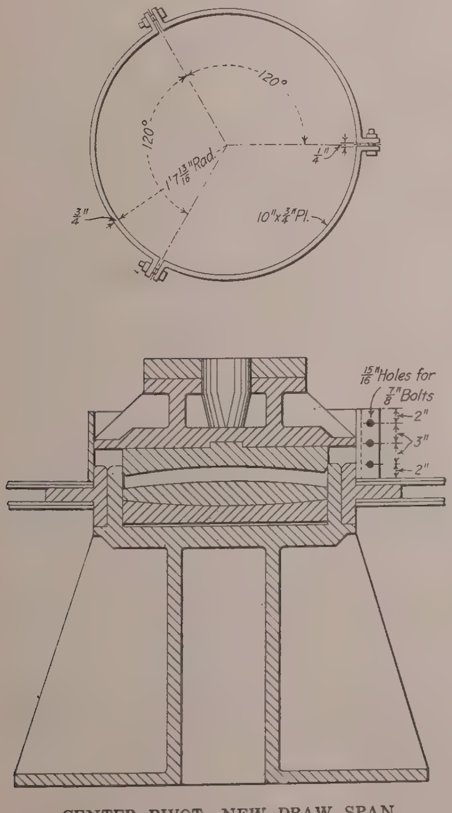
shop to guide it into the bearing chamber.

The ring held the bridge accurately centered while being lowered the remaining distance. Meanwhile the upper casting moved down inside the ring and the upper bearing entered the bearing chamber. Special care was taken to have the bridge perfectly level on the scows just as it came down on its bearings. The span was lowered about 1 p. m. to its permanent position on the turntable.

FINAL ADJUSTMENTS

Immediately after lowering the span on its bearings, the end rails were fitted into place, the necessary adjustments at the end bearings were made and all connections were made in the power transmission system. The scows were then lowered until the wedges could be released and the scows swung free below the bridge. At 4 p. m. the rails were connected and the bridge opened for traffic.

The moving of the spans was done by the Great Lakes Dredge & Dock Company, Chicago. The new concrete piers and the remodeled top of the center pier were constructed by the Cleary-White Construction Company. The American Bridge Company fabricated the structural material of the new bridge, the erection being done by the Bernhisel Construction Company. Geo. P. Nichols & Brother installed the power equipment. The bridge was designed by the engineering department of the Chicago & North Western Railway under the direction of W. H. Finley, chief engineer, and W. C. Armstrong, engineer of bridges. H. M. Spahr was resident engineer for the railway, in charge of all field work.



CENTER PIVOT, NEW DRAW SPAN

Ring at top helped guide span to its seat, being placed loose and tightened as bridge was lowered

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Contract Time Limit Binding Despite Excessive Quantities

By WILLIAM B. KING

Of King & King, Washington, D. C., Members of the Bar of the Court of Claims

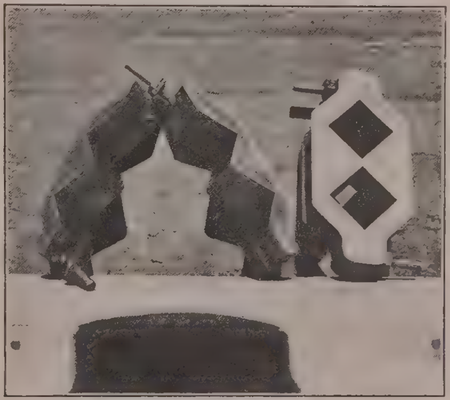
THAT quantities 10 per cent of those expected are not sufficient ground for extension of the time of a contract is established by a decision rendered Feb. 23 in the case of P. Sanford Ross, Inc. The contract in this case provided for channel excavation in the James River to produce a certain depth and width. There was a general statement of the number of cubic yards which might be expected—to be increased or diminished as the exigencies of the work might require. The specifications in stating the quantities of material made a definite statement, followed by the words "more or less." It turned out that these quantities were exceeded by at least 10 per cent in every classification. The contract took longer than the time fixed in it and the United States deducted the cost of inspection and superintendence during the extended period, this being provided in the specifications.

The contractor claimed that this deduction should not have been made, saying that the excessive quantities were the cause of the delay. The decision in Moore's case by the U. S. Supreme Court was cited, holding that, where a contract was to furnish "about" 5000 tons of coal, the government could not stop deliveries after receiving 4634 tons. The court discriminated between that case and the pending case and said that here the work to be done was definitely described and that this was the contractor's obligation. The statement of quantity, "more or less," did not supersede the description of the work required. The court said:

"The work which claimant bid upon was the excavating and removing of materials from portions of the James River. He was informed by the specification that the purpose of the excavation was to secure a depth of 18 ft. in said river below mean low water in three divisions of the work and a channel width of 200 ft. It was declared (par. 31) that material excavated from a greater depth than '1 ft. below the prescribed depth of 18 ft.,' or from outside the limits of the channel as marked, would not be paid for. These provisions, in connection with the others mentioned, show conclusively that it was not the purpose or intention of the parties that the quantities mentioned in the contract should be controlling, with a slight variation allowed for 'more or less.'"

Steel Molds Simplify the Casting of Test Cubes

FOR testing sand to be used as fine aggregate in concrete road construction a steel mold for concrete cubes has been developed by the New York State Highway Department. The accompanying photograph, showing two of these molds, the one at the left opened and the one at the right closed, leaves little to be said in the way of a description. The two halves of each mold are identical. At one end there is a brass locking bar which fits into a groove in the other half of the mold. On this bar is an adjustable nut which bears upon the curved shoulder of the mold when closed.



THIS STEEL FORM IS USED BY THE NEW YORK STATE HIGHWAY DEPARTMENT FOR SAND-CEMENT CUBE TESTS

By forcing these bars inward the two ends of the mold are brought tightly together. These molds are set up on thick slabs of glass while the cubes are being cast. The use of steel instead of brass or some other form of material makes these molds very economical.

FOREIGN COMMERCE for the fiscal year ended June 30, 1914, at the port of New York was valued at $2,140,243,057, an increase of $1,299,966,365 over the year 1886, when the first improvements to the entrances of New York harbor were begun. The total cost of these improvements to date is two-thirds of 1 per cent of this increase, or less than one-half of 1 per cent of the present annual value of the foreign commerce. The yearly tonnage of the foreign commerce handled at New York is less than one-fifth of the total annual tonnage passing through the port.

Water Filter of New Type, Tested at Toronto, Employs "Drifting Sand" Principle

Dirty Filtering Material Is Removed Continuously, Washed and Restored Without Interrupting the Normal Operation of the Unit

By GEORGE G. NASMITH and F. ADAMS
Director of Laboratories — First Assistant to Director
Department of Public Health, Toronto

WHEN it became known that an additional 60,000,000 imp. gal. per day mechanical filtration plant was to be added to the present 32,000,000 imp. gal. slow sand unit at Toronto, the John Ver Mehr Engineering Company, Limited, asked the Department of Works to consider its new system of filtration, employing the Ransome "drifting sand" unit. This system depended upon an ingenious arrangement for automatically removing the surface sand of the filtering sandbody continuously, together with the dirt which is contained, washing it and returning it cleansed into the stream of raw water and coagulant coming on to the filter. As the system appeared at first sight to be not only ingenious, but practicable, and as there appeared to be a number of advantages over the standard types of gravity mechanical filters, it was agreed that if the company built a unit of 500,000 imp. gal. capacity per day, it would be given a 30-day trial by the director of laboratories of the Department of Health, and if such test proved satisfactory, the company would be permitted to put in a tender for the 60,000,000 imp. gal. installation.

DEMONSTRATION FILTER

A site for the demonstration filter was selected adjoining the old West Toronto pumping station on Ellis Avenue, which drew water from the Humber Bay, and the plant was built there in the Spring of 1913. The site was chosen because raw water could be obtained from Humber Bay, which is always polluted with sewage and frequently muddy, and also because water could be obtained from the city mains under pressure for washing back the filter whenever necessary. The plant was put into operation during the first week of May, 1913, and was turned over to the department for the official test on May 21, 1913.

The arrangement of the demonstration plant is shown in the accompanying illustration. A centrifugal pump driven by an electric motor draws the water from Humber Bay in Lake Ontario at a point about 700 ft. from the shore and about half a mile east of the mouth of the Humber River and delivers it, together with a continuous supply of washed drifting sand from the sand washer to the center of the filter at its top. The filter consists of a vertical cylinder of reinforced concrete deeper than usual in filter design, and is nearly filled with sand. The filtered water collecting system is at the bottom, divided into small units consisting of a number of hoppers filled with graded gravel held in place by a brass screen fastened down to the concrete.

At a distance of 2 ft. 6 in. above the underdrain system and all around the filter are a series of hopper shaped ports down which the drifting sand passes. These ports converge downwards to extractor outlets, with glass inspection tubes, so that the operation of the drifting sand can be watched. The extractors are controlled by cocks which can be adjusted to suit the character of the water being filtered.

THE DRIFTING SAND PRINCIPLE

The drifting sand from the inspection outlets is collected by a ring main system along which is a current of wash water which conveys the sand to the sand-washer or sand separator. The sand-washer consists of a flat-sided hopper-like vessel with glass windows at the flat sides, through which the action can be observed. The sand-washer is attached to the filter supply pipe immediately over a constriction in it something like the form of a Venturi meter tube. An opening in the bottom of the sand-washer lets through the clean sand into the water passing, which conveys it to the filter and maintains the conical heap of sand in it.

By the well-known hydraulic principle the pressure in the pipe at the constriction is very much less than on the filter. This difference is sufficient to draw the loose or drifting sand charged with dirt out of the filter into and through the sand-washer and into the supply pipe, and so maintains the continuous motion of the sand while the filter is in operation. The sand, which by this time has become freed, but not separated, from the dirt, is led into the sand-washer at about mid-height. The weight of the sand carries it to the bottom of the washer and the dirty water escapes at the top. Near the bottom of the washer is a jet of water which carries the sand downwards into the supply pipe, displacing the dirty water upwards in so doing. The water used for washing the drifting sand is unfiltered.

The plan area of this filter is 143 sq. ft., or 0.0033 acre. The estimated surface of the stationary cone is 306 sq. ft., or more than twice the plan area. The average depth of the sand in the filter is about 13 ft., of which about 54 per cent is drifting. The minimum thickness of drifting sand is about 2 ft. 6 in. and the maximum 10 ft. The minimum thickness of the stationary sand is 2 ft. 2 in. and the maximum 13 ft.

The sand used was a local sand containing a large proportion of limestone and was prepared principally by screening out the coarser materials and washing away the finer. The physical analysis of this sand shows its effective size to be 0.4 mm. and its uniformity coefficient 2.7; it was passed through a sieve of 8 meshes per linear inch. In the drifting sand the coarser particles tend to collect in the planes of maximum travel and the finer materials to drop through the coarser, thereby offering the coarser materials to the water first and the finer materials later.

COAGULATING PLANT

A novel feature of the coagulating plant for supplying a solution of aluminum sulphate to the raw water is the employment of a large float or hydrometer-like arrangement for maintaining a solution of constant strength of about 1½ per cent, which is fed through an orifice under a constant head, the orifice being changeable. The arrangement is shown diagrammatically in the drawing and consists principally of rectangular reinforced-concrete tanks in series coated with solid paraffin.

The first tank contains water supplied from the pumping main and maintained at a constant level by a ballcock. The water from this tank may either pass direct to the bottom of the solution tank or through the needle valve at the bottom of the hydrometer tank. Solid crystals of aluminum hydrate are fed into the upper compartment of the solution tank in sufficient quantity to maintain the solution at any convenient amount in excess of 1½ per cent. The solution passes from this tank into the hydrometer tank through a needle valve at the top of the hydrometer.

Thus the hydrometer tank is supplied either with solution at the top or water at the bottom, depending upon whether the hydrometer is up or down. The hydrometer, which consists of an oak barrel with conical ends of concrete and provided with brass adjustable needle-valve points, is weighted so as to just float in a solution containing 1½ per cent of aluminum sulphate. The mixing of the two liquids takes place quite readily owing to variations in density. The heavier solution coming in at the top commences to travel downwards, producing circulation, and conversely the lighter solution coming in at the bottom commences to travel upwards, again producing circulation, with the result that stratification at the orifice cannot be detected. The solution before passing to the pump suction pipe was further diluted about 200 per cent, so that when entering the raw water the solution was of about ½ per cent. The alkalinity, as $CaCo_3$ of Great Lakes water at Toronto, is about 100 parts per million, which is capable of breaking up several times the quantity of alum that would ever require to be used.

THE OFFICIAL TEST

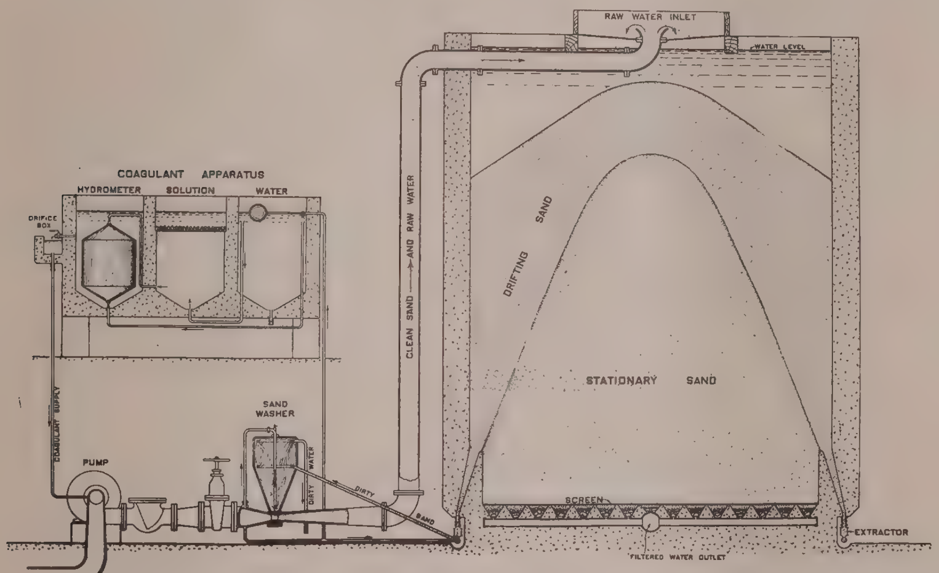
The building of the plant was watched from beginning to end, so that no detail of construction was left unknown. Every subsequent change in operation or construction was also seen by us and the filter was run off and on from May 7 to May 20, so that the plant was known to us and watched from every possible angle.

The official test commenced May 21, 1913, and ended June 27, 1913, constituting a continuous test of 36 days. On June 13 the filter was closed down for 5 hours because the West Toronto pumping station was being used as a booster station for raising the city water pressure in the western part of the city. This was a matter in no way connected with the demonstration filter, but the arrangement of pipe, etc., made it impossible during this 5 hours to get water for the filter through the intake pipe in Humber Bay. On June 15 the screen in the bottom of the filter broke, and the sand had to be taken out of the filter, the screen repaired and the sand replaced. The filter was consequently shut down on this date. On June 19 the filter was shut down because the hydroelectric power was off. With the foregoing exceptions, the operation of the filter was continuous during the period of the official test.

BACTERIOLOGICAL EXAMINATION

As a rule, two raw water samples and two filtered water samples were taken daily, and these samples plated about one hour after taken. Counts were made on standard agar at 37 deg. C. for 24 hours. Red colony counts were made on neutral-red bile-salt, lactose agar, at 37 deg. C. for 24 hours. B. coli estimations were made on standard lactose bile grown at 37 deg. C. for 48 hours in the following quantities: 50, 10, 1, 0.1 and 0.01 cu. cm. Counts on gelatin for three days at 20 deg. C. were also made, but were discarded for this reason: The filter was washed back with water from the city mains. In the city mains and in the reservoirs a bacillus multiplies at times, giving numerous yellow colonies on acid gelatin. This bacillus apparently multiplied in the filter. This yellow organism grows on acid gelatin, but does not grow on neutral gelatin such as used as a routine by Dr. Houston of London, nor does it grow on agar in the warm incubator and is of no sanitary significance. The gelatin counts were consequently disregarded.

On June 13, 14, 16 and 17 chlorine was added with the alum to the raw water to determine whether such a procedure would be suitable with this type of filter.



WITH THE DRIFTING SAND FILTER, TESTED AT TORONTO, IT IS POSSIBLE TO REMOVE DIRTY SAND, WASH AND RESTORE IT WITHOUT INTERFERING WITH THE CONTINUOUS OPERATION OF THE UNIT

Following the completion of the official test on June 26, a culture of *bacillus prodigiosus* was added to the water coming on to the filter in such quantities that the number of prodigiosus colonies per cubic centimeter in the unfiltered water varied between 204 and 600. No prodigiosus colonies appeared on the filtered water plates.

The Humber Bay water pumped on to the filter during the official test varied naturally in turbidity from 3 to 45. The filter effluent was throughout perfectly clear. Following the expiration of the official test clay in a fine state of division was added daily for three days from 7 a.m. to 5 p.m. to the water coming on the filter. The addition of clay to the raw water was not uniform, so that the turbidity of the water coming on the filter varied from 375 to 650. The filter effluent throughout this turbidity test was perfectly clear. Throughout this test 1½ grains of alum per imperial gallon were used and the filter was not washed back at any time.

Wash-Water

With this type of filter the wash-water is of two kinds. The wash-water which constantly carries the drifting sand out of the extractors to the sand-washer amounted in this test to 2 per cent of the total water filtered. This is raw water. The wash-water used to wash back the filter (about every 8 days) amounted to somewhat under 1 per cent of the total water filtered. This is filtered water. The total wash-water, both kinds, amounted to slightly less than 3 per cent of the total quantity of water filtered.

The loss of head in the filter, immediately after washing back, when filtering at a rate of 500,000 imp. gal. per day was about 7 ft. Over a period of 8 days' operation the loss of head commonly increased to 14 ft. It was found advisable to wash back the filter only about every 8 days.

Operating Results

The average rate of filtration for the 36-day test was 140,000,000 imp. gal. per acre per day. During the first 11 days the amount of alum used, in grains per imperial gallon, was 0.75; for the next 13 days, 1.5; for the next 6 days, 1; and for the remaining 6 days, 1.5.

For the entire test period the average raw water bacterial count on standard agar at 37 deg. C. was 1365 per cubic centimeter, and for the filtered water 13, giving an efficiency of 99.0 per cent.

The average raw water red colony count on neutral-red bile-salt, lactose agar, at 37 deg. C. was 106 per cubic centimeter, and for the filtered water 0.7, giving an efficiency of 99.3 per cent.

Hot Irons Instead of Brushes are used in spreading joint fillers over the top of wood-block pavements now being laid on Main Street, Kansas City. Four irons are provided, two being heated while the other two are in use. Clark R. Mandigo, assistant city engineer, states that the filler penetrates the joints quickly at the point where it is spilled from the cans, but when pushed any distance by brushes the thin layer cools rapidly and the increased viscosity keeps it on the surface. The hot iron squeegee increases the fluidity, thereby insuring an even penetration. Blocks are laid on a cement grout cushion, 1:4 mix, to prevent shifting.

Painting Steel to Prevent Electrolysis

Oils Drying Flat and Containing Pigments Forming Rough Non-conducting Films Found Best—"Sanding" Increases Bond

Reinforcing steel embedded in concrete which is so located as to be subject to the action of stray electric currents is in danger of being disintegrated by electrolytic action, especially in the presence of moisture. It has been proposed, as a preventive measure that such steel be given a protective coating of paint, although the weakness of the bond or adhesion between painted steel and concrete was generally deemed so important an obstacle to this practice as to condemn it entirely. Further, previous tests seem to have shown that common paints are not absolutely impervious to moisture. In an article appearing in this journal more than a year ago (Vol. 69, 1914, page 38) E. B. Rosa and B. McCullum discussed the results of tests of over forty common paints, of which not one withstood a potential of 4 volts for any length of time, pitting of the steel occurring within a few months in all cases. They concluded that common paints may even increase the tendency to dangerous electrolytic action because of the concentration of such action in small areas where the paint films break down.

New Tests

New light is now thrown on these questions by an article entitled "Paints to Prevent Electrolysis in Concrete Structures," by Henry A. Gardner, assistant director of the Institute of Industrial Research, Washington, D. C. This article, printed in the March issue of the "Journal" of the Franklin Institute, contains a complete discussion of the results of about fifty tests on painted steel rods embedded in 1:2 Portland cement mortar cylinders. Two series of tests were made, differing mainly in the fact that the second series was continued for only 300 hr., 240 hr. under 30 volts and 60 hr. under 55 volts, with the cylinders always immersed in water up to within 1 in. of the top surface.

The first series of tests was made as follows: At the age of one month the cylinders were all connected up in parallel for 24 hr. under 30 volts; then, since the current passing was found to be very small, they were placed in about 2 in. of water for one week. In a few cases it was found that cracks appeared near the bottom where moisture had affected the films of paint. They were then immersed in water up to within 1 in. of the top and continued under 30 volts for 10 days longer.

In all cases the current readings were made daily, and cracking was shown whenever the current was appreciable. The painted rods were given two coats of the paint to be investigated, allowing an interval of one week for drying. Bituminous paints, oil paints, aqueous paints, lacquers, and oils and varnishes were tested. Two specimens contained unpainted rods which showed much earlier cracking and disintegration. It is impossible to give here the results in detail, but in general it was found that bituminous paints, a few oil paints, lacquers and varnishes gave the best results.

Tests of Bonding Strength

In order to determine the effect of paint upon the adhesion between steel and cement mortar a similar set of specimens was tested in a Riehle testing machine. Pressure was applied upon the painted iron rod projecting from the top of the cylinder until the bond was destroyed, and the comparative strength thus determined. Some of the water paints and lacquers showed bonding strength about as high as the plain steel, but failed to act as insulators; while others were good insulators, but low in bonding strength. Most of the oil-pigment paints made with raw linseed oil gave poor or only fair results, while much better results were obtained with boiled linseed oil, which dries to a harder, less porous, and more fully saturated film.

A very effective method for increasing the bond between the painted steel and concrete is to "sand" the painted surface just before it becomes dry. This produces a rough surface, which was found to increase the bonding strength as much as 100 per cent in one instance, and to give much better insulating values.

Important Results and Electrolytic Action

Wherever there were voids in the surrounding mortar, at or around the painted rods, corrosion was most severe, and pitting was shown. The breaking down of a paint film, probably due to its having been broken through by enclosed hydrogen gas developed by the electrolysis of the water in the damp concrete, was always recorded by a sharp rise in the amount of current passed, and a noticeable fizzing sound. Bubbles of gas which burst with an audible explosion when lighted were brought to the top around the iron electrodes, sometimes carrying soft oily products. Such disintegrating effects of electrolytic hydrogenation might be prevented by thoroughly oxidized coatings, which could be obtained by allowing a period of 60 days for the drying of oil paints before using in the cement.

Paints which form highly impermeable films keep water away from the underlying iron and offer great resistance to the passage of electric currents. Previous investigations made by Mr. Gardner have determined the actual degree of porosity shown by various types of paint films, as reported in Bulletin 18, Scientific Section, Paint Manufacturers' Association of United States. The addition of a pigment to an oil usually increases the resistance to moisture and makes a more impermeable film.

Conclusions

The corrosion of metal embedded in concrete structures, by stray currents of high voltage, is often productive of serious effects. The use of properly-made paints upon such metal constitutes a safeguard that should not be neglected by the engineer. Such paints may be prepared from the following substances.

The vehicle should contain: (1) Boiled or bodied oils or products which dry to a fairly saturated film. (2) Oils which dry by semi-polymerization rather than oxidation. (3) Oils which dry to a flat rather than a highly glossy surface.

The solid portion should contain a percentage of: (1) Pigments which are coarse and which, therefore, tend to form films having a rough surface; (2) pigments which are inert and which do not act as conductors of electricity; (3) pigments which are either basic or of the chromate type.

The painted metal should be "sanded" if possible.

Literature

For the Civil Engineer and Contractor

New Publications

The Official Good Roads Year Book of the United States. Edited by I. S. Pennybacker. Cloth, 6¼ x 9¼ in.; 498 pages; illustrated. Washington, American Highway Association, Colorado Building.

Centrifugal Pumps. By R. L. Daugherty, A. B., M. E., assistant professor of hydraulics, Sibley College, Cornell University. Author of "Hydraulic Turbines." Cloth, 6¼ x 9½ in.; 192 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $2 net.

Report of the Boiler Code Committee of the American Society of Mechanical Engineers. Paper, 6 x 9 in.; 114 pages; illustrated. New York, American Society of Mechanical Engineers.

Rules for the construction of stationary boilers and for allowable working pressures, applying to new and to existing installations.

Report of the Chief of Engineers, U. S. A., to the Secretary of War, 1914. Paper, 6 x 9 in.; 1565 pages and 51-page index; tables and maps. Washington, Government Printing Office.

Annual report covering history, cost and financial benefits of the river and harbor improvement work; coast defense work; the Great Lakes survey; Government requirements concerning bridges, obstructions and uses for power developments of navigable rivers, etc.

Electric Railway Handbook—A Reference Book of Practical Data, Formulas and Tables for the Use of Operators, Engineers and Students. By Albert S. Richey, E. E., consulting engineer, professor of electrical engineering, Worcester Polytechnic Institute, and Fellow of the American Institute of Electrical Engineers, assisted by William C. Greenough, E. E. Limp leather, 4½ x 7 in.; 832 pages, illustrated; diagrams and tables. New York, McGraw-Hill Book Company, Inc. $4 net.

Some Economic Problems of Railroad Valuation. By A. M. Sakolski. Reprinted from the American Economic Review, Vol. V, No. 1, March, 1915; published by the American Economic Association. Paper, 6¼ x 9¼ in.; 15 pages.

While this work is very brief and can not go into the intricacies of railroad valuation in detail, it gives a good bird's-eye view of the subject and lays proper emphasis on certain points often overlooked, such as the difference between depreciation as a measure of physical depletion and depreciation as an accounting problem to take care of final renewals.

Report of the State Engineer of Nebraska for 1913-1914. 2 volumes, cloth, 6 x 9 in.; volume 1, 356 pages, illustrated; volume 2, 382 pages, illustrated. Lincoln, Neb. Donald D. Price, State Engineer.

The first volume explains the work of the State Board of Irrigation, Highways and Drainage for the past two years. It contains a history of irrigation development, explains improvements due to irrigation, gives data on the canals at various projects and the construction of drainage and irrigation ditches, highways and State-aid bridges, etc. Volume 2 contains details of the hydrographic work done, including surface water measurements and complete tabular data for various rivers and discharge of smaller streams.

Books Reviewed

American Sewerage Practice—Vol. II—Construction of Sewers

Authors, Leonard Metcalf and Harrison P. Eddy. Cloth, 6 x 9 in.; 564 pages, 181 illustrations. New York, McGraw-Hill Book Company, Inc. $4 net.

Reviewed by Charles E. Gregory

Engineer in Charge, Bureau of Sewers, Borough of Manhattan, New York

Volume 2 of "American Sewerage Practice" by Metcalf & Eddy fulfils the expectations engendered by Volume 1. It covers all of the engineering work of carrying out in the field the construction of sewers under the varying conditions met with in modern practice, and includes numerous typical examples with illustrations. It begins with the preliminary field surveys, soundings and borings and explains each step until the sewer system is completed and accepted. Construction methods and contractor's plant are fully described and illustrated. Specifications and sewer maintenance are also discussed.

A very valuable feature is the descriptions of specific works and operations which have been met with in the experience of the authors, since the application of similar plant or plans to other conditions and places can be made by taking into account the differences in financial and physical conditions and requirements and modifying for them accordingly.

Each subject has been set forth in detail, but there has been some repetition of data and theory when quoting opinions and writings of others. Much-needed and pertinent theories of design and structural details of forms and centers as well as of trench and tunnel sheeting and timbering are included as a part of construction rather than design. It is apparent that the authors have intended to instruct so fully about the detailed execution and inspection of sewerage work that more exact standards and better structures may result.

The first chapter points out the need for better inspection and execution of sewer construction and suggests a form of organization for the engineering corps. This is followed by instructions for laying out the work on the ground, supervision and inspection of the construction work, making specific mention of the more important materials used. Blank forms for cost keeping and progress records with directions for their use are given.

Six chapters are used to cover excavation, the most uncertain part of sewer construction in its effect upon both cost and rate of progress. Open cut and tunnel work are described, although tunneling is not covered so completely as open-cut excavation. The various materials to be excavated are described and classified. Methods and machines used for the various conditions are described and illustrated. Explosives and their care and use are fully covered.

The practice of tunneling for short distances in shallow trenches is suggested as an economical method but in the writer's opinion should not be allowed, especially if the street is paved or is to be paved in the near future. Such a practice would lead to subsequent settlement and destruction of the paved surface.

Quantities and costs are given with useful diagrams and tables. Rates of progress are concisely dealt with, and Table 36 gives rates of progress in tunnels through different materials. Practice varies in different parts of the country, and the authors point out that it is not customary to distinguish between earth and rock excavation when contracting for sewers in some far western cities.

Two chapters cover the important work of bracing and shoring trenches. The theory of earth pressures is exhaustively treated and the danger of using theories which are based upon assumed conditions which are often not even approximately correct, is pointed out. Practical methods for obtaining safe results in conformity with the best practice are given, also tables and diagrams of sizes and quantities.

Four chapters take up in detail the materials from which the sewers are made, including vitrified clay pipe and iron pipe, as well as sewers of brick, concrete and vitrified blocks, and describe in detail how they are purchased, inspected, handled and incorporated into the structures.

A chapter is devoted to the very important work of designing and using forms, centers and profiles. The construction and use of a suitable form or center for unusual shapes, or a form for a usual section so designed as to be readily used a great number of times without distortion or harmful leaks, is a matter of great importance if sewers are to be built true to shape and with smooth inner surfaces. Numerous examples of successful work are described and illustrated.

Two chapters have to do with drawings, and specific emphasis is placed upon the need for clear, exact language and complete drawings.

In the larger cities a contract form best suited to cover the legal difficulties has been worked out through experience gained in disputes with contractors, which have resulted in court decisions which serve as precedents for future cases. The contract form given by the authors is complete but should be modified and abbreviated in places for special localities.

The technical specifications are complete for usual work, but possibly include more description of methods than would seem necessary or advisable to those who prefer to give the contractor greater liberty in choosing methods.

One chapter is unique in that it contains valuable data relative to the maintenance of sewer systems. This subject has been much neglected and there is a real need for the establishment of standards of practice and for an interchange of data relating to methods and costs.

The last chapter is entirely devoted to the discussion of "explosions in sewers," and concludes that the great increase in such explosions is due to the discharge of gasoline from garages. Various opinions as to causes are quoted and there is some repetition of data as a result of some articles being to a certain extent compilations of data from others.

The book as a whole is up to date and complete and will be exceedingly useful to both engineers and contractors.

Masonry

Author, Malverd A. Howe, professor of civil engineering, Rose Polytechnic Institute. Cloth, 6 x 9 in.; 160 pages; 115 illustrations. New York, John Wiley & Sons, Inc. $2 net.

This book is a very concise treatment of the subject of masonry construction for use as a textbook, and wisely makes no claim to completeness of presentation. It is designed to be used as the basis of a short course on masonry in institutions where but a limited amount of time can be allowed for the subject. There is a very complete list of references, covering six pages, for those who can pursue supplementary reading; but, as usual in such lists, no indication is given of the relative value and trustworthiness of the different articles and books, nor of their exact contents.

The book is divided into three parts: Part I, "The Materials," consists of two chapters, one describing natural building stones and the other artificial building materials. Part II, "Masonry," treats in three chapters the subjects of stone, brick and hollow-tile, and concrete masonry. Reinforced concrete is not included, the author stating in the preface that there are already numerous books which treat that subject fully. Finally, Part III on "Specifications" contains one chapter, and is followed by the list of references mentioned in the first paragraph.

Part I contains the conventional definitions and classifications of natural building stones, but is brought up to date by illustrations of modern quarrying machinery and power tools, which are also concisely described. Most of the illustrations are taken from manufacturers' catalogs. The subject of manufacture of brick is well treated, and modern methods of burning are fully described. Another new feature is the section on modern forms of hollow terra-cotta or tile, with illustrations of wall and arch blocks. Lime and cement are rather inadequately treated in only six pages, and sand, gravel and mortar are also dismissed in a few pages.

Part II, treating masonry, covers the whole subject in about 60 pages, including many illustrations. Beginning with the usual definitions and classifications, the subject of stone masonry is concisely treated in the usual manner, and includes illustrations of modern forms of grab hooks, clamps, and dowels, etc., for handling stone. Brick and hollow tile masonry are given but 10 pages, and 34 pages are devoted to concrete masonry. The discussion of the latter important subject is practically confined to definitions and short descriptions, based upon illustrations, of mixers, concrete blocks, mixing and depositing plants, bottom-dump buckets and tremies for placing concrete under water, etc. The modern methods of placing concrete and grout under pneumatic pressure are described, and the cement gun illustrated and explained. Various surface finishes, forms and form clamps, waterproofing methods, tests of permeability, and effects of alkali on concrete are described, and followed by a very condensed statement of average values for the physical properties of concrete.

The final chapter contains abstracts from the "Manual" of the American Railway Engineering Association, on definitions and specifications for stone masonry and for plain concrete, and from the recommendations of the American Society for Testing Materials on standard specifications for building brick, lime, sand and cement.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

How Can Annual Reports Be Improved?

SIR: Public works engineers should read Professor Swain's views on the engineer's deficiencies in your issue of Feb. 27, and should then turn back and read your editorial on improving annual reports. After reading these two articles, they should read their last annual reports and carefully analyze the connection between the three.

Professor Swain says: "It is an opinion that is very widely held, and particularly among engineers, that the engineering profession is not appreciated at its full value, and that the engineer does not receive the recognition in public life, and as a leader, that his attainments entitle him to receive." Mr. Public Works Engineer, why should you be appreciated? Read the annual reports of the departments of public works of the leading cities and see if you can advance any reason for being appreciated.

Quoting from the editorial, "This journal can see no reason for filling dozens of pages with tables showing the number, size and location of valves. This information is valuable. Its place, however, is in the office files and not in a report sent out broadcast." We even go further in our annual report of the Bureau of Engineering. Work done by the different divisions is shown in detail if the unit costs are shown, thereby making them of value to the engineers of other cities. If detail costs are not given, the report is not published.

We have in the past published engineering reports on engine and boiler tests, locations of new feeder mains, etc. A new policy has been adopted for these reports, and has been carried into effect as far as one report is concerned. Pamphlets, standard city size (the same as the University of Illinois bulletins) are published and distributed as called for. In this way the size of the annual report is kept down and much postage and waste of material are saved.

We are also trying to eliminate all superfluous tables and reading matter. It is true that the 1914 report, to be published, does not reach the ideal expected, but it is hoped that with constructive criticism of the annual reports that are published this year, the ideal will be more nearly approached next year.

C. C. Saner,
Designing Engineer, Bureau of Engineering, Department of Public Works.
Chicago.

Highly Specialized Engineering Needed in Water-Power Design

SIR: A certain phase of water-power engineering has long been forced upon the writer's attention, on account of the opportunity he has had to observe the economic effect of the principles of design, the importance of which is sometimes insufficiently considered. This phase is the relatively careless attitude of mind toward hydraulic losses as compared with electrical losses, which stands out so prominently in many of our plants, especially the older ones. The old-fashioned idea of developing a water power was to order a wheel from the manufacturer's catalogue, and, starting with a knowledge of the diameter of the hole at the wheel-case entrance, to contract for a pipe that would fit the hole and arrange in some more or less crude way to get water into the pipe.

The electric end of the job, however, has long been and even now is, in a far more refined state than the hydraulic. Great stress is laid on electrical efficiency and strict attention is paid to ½ per cent more or less as determining the maximum fitness of apparatus, but the same careful consideration is not ordinarily given to the conservation of head and to the turbine efficiency. This neglect is often due not so much to a fault of the engineer as to his inability to impress upon his client the value of spending a little more money to accomplish the best results. Then, too, there seems to be an unwarranted prevalence of opinion that hydraulic losses, as roughly computed, are inevitable, and the idea of cutting them down, say, 1 per cent, is certainly not given the same weighty consideration a similar possibility in the transmission losses, for example, receives.

It should be borne well in mind that a matter of 6 in. of head on, say 50 ft. total available fall, may mean 1 per cent more or less of gross earning capacity, and when the fixed charges, operation, etc., are subtracted, it means a considerably larger percentage of the net earnings. Thus it appears that in some instances, overlooking an opportunity to save 6 in. might sadly affect the stock dividends.

An apparently unimportant eddy at the entrance to a pipe line may be passed over as trivial, when its chief harmful influence is, perhaps, not so much the local loss accompanying it, as the tortuous entrance given to the water, which causes a steeper hydraulic gradient, far along the pipe line.

The writer's opportunity to observe the practical effect of care in the design of transition sections, entrances, tees, elbows, etc., has been somewhat exceptional, and therefore, he feels justified in calling particular attention to this phase of water-power development. That there are numerous plants in existence where substantial gains in output could be effected by a few well placed and highly justifiable modifications, is an unquestionable fact.

Electrical machinery of various makes rarely differs by more than about 1 per cent in efficiency, but different designs of waterwheels for supposedly the same physical requirements, may and do vary as much as 10 per cent; although this, of course, does not represent the variation among the best of them.

The point which it is desired here to impress is that the proper conservation of head is of prime importance to the investor in water-power projects, and that the best results can be obtained only through highly specialized engineering of a quality comparable to that which is universally recognized as necessary for electrical design. It would seem altogether superfluous to call attention to such an obvious matter, but the writer ventures to assert that very many of his fellow engineers in the water-power line recognize the desirability of a more serious attitude of mind toward the design of the so-called commonplace features of a plant.

R. D. JOHNSON,
Hydraulic Engineer.

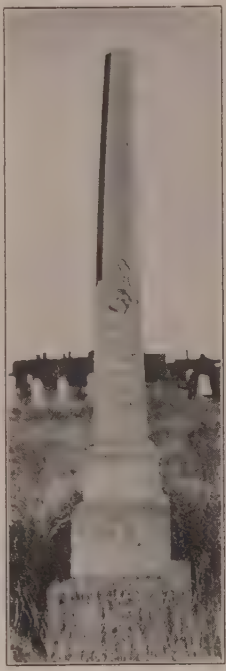
New York City.

A Warped Stone Monument

SIR: The accompanying photograph illustrates what, to the writer, at least, is unique. It is merely a monumental shaft of very ordinary design and appearance, but an inspection will show that the shaft is slightly warped or curved to the right. When the writer first saw the stone, in an old cemetery at Canon City, Col., he thought the curve was intentional, due, perhaps, to some freakish imagination, such as are so often allowed to run riot on monuments and epitaphs. On looking around the cemetery, however, three or four more were discovered with the same characteristics. With but one exception the concave side was toward the south; the exception curved eastward. The stone is apparently a white marble, which has become so weathered as to give it the appearance of a very coarse quartz-like sandstone.

The shaft, which is about forty years old, is 6 or 7 ft. high. The curve which the shaft takes has a middle ordinate of approximately 1 in. in a chord of that length.

No logical explanation of this curvature or warping has as yet occurred to the writer, who would greatly appreciate any enlightenment on the subject which your readers might be able to give.


A WARPED MONUMENT

R. C. HARDMAN.

Colorado Springs, Col.

[While the foregoing is interesting it is not unusual for marble to warp. Atmosphere, heat, light, wind and rain all have their effect. Monumental slabs are known to act in such a manner, while marble left leaning against a wall or other object will invariably warp.—EDITOR.]

Status of the Engineer

SIR: Your editorial and Professor Swain's address on the status of the engineer, in your issue of Feb. 27, are interesting if true, but are they true? Isn't it true that except in certain matters of political preferment engineers have achieved as much recognition as men of any of the other professions, whether they be lawyers, doctors, dentists or any others?

Engineers certainly have shown themselves fully as capable of leadership as men of the other professions, even in the ranks of business and finance. We need look no further than to the heads of the Pennsylvania Railroad through several administrations, and of more than one manufacturing concern, and surely the Panama Canal is a fresh enough and most conspicuous instance of executive ability and clear thinking not to be forgotten so soon. What lawyer or business man could have done better, and how many as well?

One trouble is that just as soon as an engineer drops his purely technical work he is often no longer classed among engineers, but as a business man, whereas a lawyer is always a lawyer even though he be an alleged statesman.

Many of the executive positions under our Federal and State Governments, especially in the public service and other commissions, could be in a great many cases better filled from the ranks of the engineers than from those of lawyers. The latter, however, take to politics as a duck takes to water and they get whatever is going in the way of political plums.

Under our form of government, this is to some extent inevitable, but somehow or other we manage to struggle along and achieve results that on the whole are not altogether inferior to those achieved by the rest of the world. That isn't to say we might not do much better, however, but surely neither you nor Professor Swain will say there could not be found in the State of New York, or for that matter in any other State, two or three or four engineers quite as capable of filling the position of public service commissioner as any man who has as yet held that office, or that one or more such engineers on each commission would not be a benefit. All this with all due respect to the men who have held such positions, for no matter how able they may have been—and many of them have been able—I think we could undertake to match one out of five with an engineer, both for technical ability, breadth of view, business judgment and plain horse sense.

I for one refuse to believe that engineers have less common sense or think less clearly than men in any of the other professions, be they politicians, lawyers, doctors or clergymen, or less ability than business men. Look around at any of these professions, and instead of picking out the shining lights and stacking them up against the average engineer, who has had his nose to the technical grindstone, put them up against the engineers who have done things.

However, it will not do any harm to urge on engineers the necessity of knowing something of the affairs of the world, to do all they can to broaden their vision, and above all, as Professor Swain has said, remember that mathematics has about as much relation to engineering as knowing how to sew has to making a well fitting coat. We can all bear in mind, too, that it is not beneath the dignity of the engineer to evince some interest in civic affairs. It isn't because the average lawyer who holds public office, is any clearer thinker or any broader minded than the average engineer that he gets political positions, but because he has been on the job and worked to that particular end. And there's plenty of honor and plenty of money outside of political preferment.

There are men in every profession who realize nothing outside of the technique of their particular line, but in this respect, engineers are no worse than any of the rest. As long as they do this they will stay in the rut. Those who get outside, however, achieve some distinction, and there are some of the latter in all professions alike.

F. LAVIS,
Consulting Engineer.

New York City.

FUEL OIL can now be readily supplied to vessels at each entrance to Panama Canal, according to the "Canal Record," and the facilities will be extended as the occasion arises. Oil is sold by both Government and private corporations. At Balboa there is storage capacity for 220,000 bbl. of fuel oil and 37,000 bbl. of Diesel-engine oil, while at Cristobal 195,000 bbl. of fuel oil can be stored. Diesel-engine oil is not sold at the latter point.

HINTS FOR THE CONTRACTOR

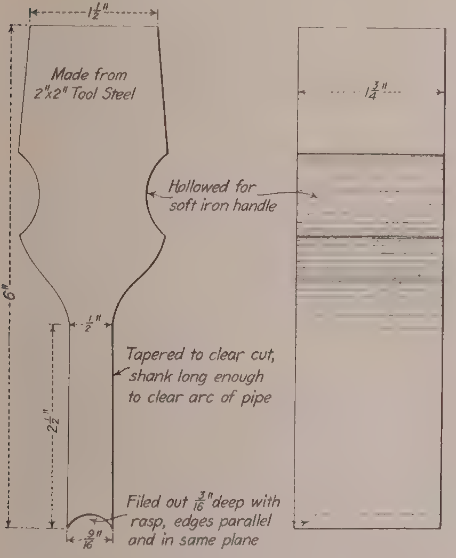
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Special Hardie Cuts 20-Inch Steel Pipe Quickly

By HAROLD F. JOHNSTON
Special Engineer, Parks Branch, Department of the Interior, Banff, Alta.

THE special hardie illustrated herewith was effective and economical in cutting odd lengths from full lengths of 20-in. steel pipe during the recent construction of a 2½-mi. auxiliary water main for the town of Banff, Alberta. The writer does not claim to have originated this hardie, which he believes came originally from Los Angeles, and which has also been used in Calgary.


1½"
Made from 2"x2" Tool Steel
1¾"
Hollowed for soft iron handle
6"
½"
Tapered to clear cut, shank long enough to clear arc of pipe
2½"
Filed out 3/16" deep with rasp, edges parallel and in same plane
9/16"

HARDIE USED TO CUT STEEL PIPE

The tool was forged from 2 x 2-in. tool steel, and particular care was given to the working of the shank. This shank is tapered 1/16 in. to give clearance above the cutting edge and avoid binding. The cutting edge is double, formed by hollowing out the face of the hardie with a rasp. The edges must be parallel and in the same plane to insure an even, clean cut, following the desired line.

A hole must first be made in the pipe with a diamond point which is ⅝ in. across the diagonal. The cut is then begun with the hardie, which must be held with the cutting edge perpendicular to a tangent to the pipe at the point being cut. As the cut proceeds a ribbon of steel curls away, and an even, clean edge is left.

Three men, one holding the hardie and two using 8-lb. hammers, could cut a 20-in. steel pipe of ¼-in. metal in 25 min. The combined wages of the three men were 85 cents an hour. The cost was, therefore, 35.4 cents for making a cut 5.23 ft. long. A cut at any angle to the axis of the pipe may be made as easily as a perpendicular cut.

Wet Concrete Hauled from Central Plant on River

Three Automobile Trucks Holding Four Yards Each Transport 360 Yards in Eight Hours from Mixing Plant to Forms on New York Subway Section

A CONCRETE plant consisting of a 2-yd. mixer, overhead bins fed from barges by a derrick, and three automobile trucks, has placed 360 cu. yd. of concrete in eight hours on New York subway work. Concreting on this subway work has been difficult on practically all the contracts. The fact that the work is covered with streets under heavy traffic, together with the lack of head room, and of sufficient volume of concrete in one place to justify mixing plants in the cut, has forced the contractors to use low-capacity wheelbarrow-fed portable mixers wheeled along the street, and to do much mixing by hand. The small volume of concrete in most of the work has contributed to this condition.

CONDITIONS ON LEXINGTON AVENUE

On section 13 of route 5, however, which extends on Lexington Avenue from 118th to 129th Street, conditions were favorable for a more modern and efficient plant. This section involves track-separation work, which calls at one point for seven tubes, is on two levels all of the way, and contains the 125th Street express station. Thus it will be seen that more concrete was required than in the average section. Further an invert 4 ft. thick for a good part of the lower level furnished a large volume of concrete which could be placed in considerable quantities at each operation. The tower system of carrying the street loads, described in the Engineering Record of Nov. 22, 1913, from the floor of the invert, used in the rock sections where no cross-bracing was required, allowed the side walls and roof to be concreted in the clear. The total concrete in this section is more than 55,000 cu. yd. The best day's run under these conditions, which was for placing invert concrete, was 360 cu. yd. in eight hours, and the average run for August and September, 1914, 170 cu. yd. every working day.

Even under these conditions, however, any plant installed on this section had to be capable of running economically on the "short" days when often less than 10 cu. yd. per hour could be placed. These short days came chiefly in concreting the thin arch walls, above the 125th Street station, where the cut ran partly out of rock, and the necessity of shifting bracing as the concrete came up delayed the work.

There was dock space available on the Harlem River at the foot of 125th Street, which location gave an average round trip of only 1¼ mi. to the job.

POSSIBLE LAYOUTS

To haul materials to the job would have required the use of primitive mixing facilities, which would have thrown away all the natural advantages of the section for placing concrete economically. To mix dry batches at the dock, as has been done on subway work, would also have thrown away this advantage, for the reason that if large enough batches were hauled to

MOTOR TRUCK AT LEFT TAKING LOAD OF WET CONCRETE AT MIXING PLANT AND AT RIGHT DELIVERING IT TO FORMS place concrete reasonably fast with a small number of trucks, great difficulty would be encountered in remixing them with water, while if small batches were hauled, such an excessive force of trucks and men would have been needed to place concrete rapidly that they would have actually been in each other's way.

The plain answer to the problem was a wet mixing plant at the dock, and a few large-capacity trucks. The trip could be made in plenty of time to prevent setting of the concrete, but many other serious difficulties had to be overcome which are not encountered in the usual concrete layout.

EQUIPMENT OVERCOMES DIFFICULTIES

As large capacity and speed were essential in the concrete conveyances, three motor trucks holding 4 cu. yd. each were provided. As this plant had to be used on the other work when concreting was slack, trucks with convertible bodies which could assist the teams in handling dirt skips were desirable. The 7½-ton Mack trucks, which have been on the job three years, are said to have met these requirements in an unusual way, and to have been thoroughly dependable in service.

Bins holding 480 yd. of stone, 160 yd. of sand and 8000 sacks of cement, fed with a clamshell derrick, were erected at the dock over a 2-yd. mixer under which the motor trucks backed to receive their two-batch load. Sand and stone are drawn from eight gates, under the center line of the bins, into a 2-yd. car. This car is operated by an endless cable on a swinging engine, the throttle lever of which is set half way between the mixer and the last gate, so that the man operating the gates can reach it. One man on ordinary runs, and two on heavy days, do the entire work of charging the mixer. An engineer for the mixer and one for the derrick complete the force. A foreman and four men are kept at the dock to assist in unloading and handling cement on heavy days. When concrete work is slack, however, this crew is busy loading rock from the cut on barges, drying sand and preparing waterproofing material, etc., so that the overhead on this plant when running light is very low.

TRANSPORTATION AND DELIVERY

To prevent the aggregate from settling to the bottom of the trucks in transit, the concrete is mixed rather dry. It is easy to put stiff concrete into a motor truck, but sometimes hard to get it out. The trucks have a back-tilting power dump, and the best results in releasing the load have been obtained with a home-made gate, the full width of the truck and 15 in. high, in the bottom of the rear door. A jet made of ½-in. pipe, and supplied with air from the drill plant, is thrust into the load about two feet behind the door, and blows out the concrete next to the bottom of the truck, allowing that above to run out easily. The load is then "sliced" out with this jet as fast as it will go down the chute. One man to handle the jet, and another to add a little water to the mixture with a hose, and feed it down the chute, are all that are required at the receiving end.

The load is dumped into a low wood hopper, from which telescope sheet-steel chutes, made in 8-ft. lengths, are hung through a hole in the decking to the forms. This hopper is mounted on skids, and to move it the chutes are detached and the hopper is tied on behind the motor truck, which drags it up the street to the next hole in the decking.

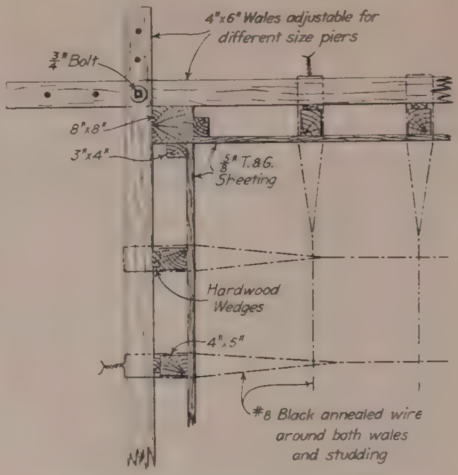
Although no figures can be given out, it is understood that this concrete installation has more than paid, and has enabled the contractor, the McMullen, Snare & Triest Company, Inc., to carry out profitably a part of the work which has proved vexatious on many other subway contracts. At the present time this work is in charge of Robert Eldridge, superintendent, and H. V. R. Thorne, chief engineer, for the contractors. The Public Service Commission for the first district is represented on the contract by R. A. Fiesel, and the third division is in charge of C. V. V. Powers, whose assistant is J. P. Locke.

Column Forms Hold 30 Feet of Wet Concrete

By P. A. McGEADY
Washington, D. C.

CONCRETE had to be poured continuously from top to bottom in constructing columns and piers for the Lincoln Memorial at Washington, according to the contract specifications. This required in some of the columns a continuous pour 37 ft. high. Consequently, the contractor for this portion of the work had to design some unusual form work. Steel forms were at first considered, but the fact that a large number of forms would have to be set up at once in order to complete the work within the time limit made this type of form too expensive.

The wooden tower forms illustrated in the accompanying sketch and photograph were then designed by the writer, and proved entirely satisfactory. The corner posts of these forms were made up of one 12-ft., two 10-ft. and one 5-ft. sections, for convenience in handling. In striking the forms the lower three sections were removed and used elsewhere, while the 5-ft. section was left in place to carry the arch form work for the floors. Some of the smaller columns, 3 x 6 ft. in plan, were poured to a height of 37 ft. in 1½ hours, and the weight of wet concrete in all of the columns was much in excess of that which form work is ordinarily called to support. Sheathing ⅝ in. thick was used for these forms, although 2-in. material was originally planned for. These forms in all cases withstood this severe test without serious deflection.


4"x6" Wales adjustable for different size piers
$\frac{3}{4}$" Bolt
8"x8"
3"x4"
$\frac{5}{8}$" T.&G. Sheeting
Hardwood Wedges
4".5"
#8 Black annealed wire around both wales and studding

CORNER CONSTRUCTION IS ADJUSTABLE

As may be seen from the sketch, the framework of the forms was adjustable to several sizes of pier. This adjustment was accomplished by bolting the wales together at the corners through different holes, and moving the corner studs in or out. These corner posts are specially made with this end in view, and were not fastened to the wales except as they were held by the sheathing.

THE LOUISVILLE & PORTLAND CANAL was turned into a Government waterway by a process of gradual absorption, states the annual report of the chief of engineers, U. S. A. As far back as 1826 the Government purchased stock in this canal, a project then under construction by a private corporation. The Government gradually increased its holdings until it owned all the bonds and stock of the company. The canal, however, remained under corporate management long after this, or until 1874. The Government continued to operate the canal under the old toll plan, however, for six years longer; and it was not a free waterway until 1880.

PIER FORMS HOLD CONTINUOUS POUR OF CONCRETE MORE THAN 30 FEET HIGH

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Penstock Breaks Cripple Seattle Power Plant

Failure of Two Wood-Stave Pipe Lines from Cedar Falls Dam Cause Shut Down of Municipal Hydroelectric Works

Breaks in both of the wood-stave penstocks leading from the new Cedar Falls masonry dam put the municipal hydroelectric plant of the city of Seattle, Wash., out of commission on April 5. The power load was immediately transferred to the auxiliary steam station at Lake Amon so that power and lighting service to the city was not cut off. The breaks, which were located 1000 ft. from the dam, did not interfere with the water supply, for the water mains extend from an intake basin at Landsburg, 12 miles east of Cedar Falls.

It is believed that an unusual volume of water in the river, caused by heavy rains, undermined the foundations of the wood-stave pipe lines which, for part of their length, are laid in the river bed. A similar accident occurred in 1911 when a crib dam, above the site of the present masonry dam, was carried away by high water.

The wood-stave penstocks which failed have diameters of 49 and 68 in. respectively and originally tapped the Cedar Lake reservoir formed by a small wood-crib dam erected in 1902. This dam has been superseded by the new cyclopean concrete structure, 215 ft. high and about 1000 ft. long, shown in the accompanying illustration. The new dam is 9440 ft. from the power house, while the distance to the old dam was about 16,000 ft.

The 49-in. wood-stave pipe, built in 1904, is composed of 30 staves cut from 2 x 6-in. stock. The 68-in. pipe was built in 1908. It is made of 30 staves cut from 2½ x 8-in. stock. The bands are of wrought iron, designed with a factor of safety of 4. The highest head under which the wood-stave pipe operates is 310 ft. and the sharpest curve is 18 deg.

Many engineering difficulties were encountered in laying the pipe lines. Where it was necessary to turn with a sharper radius than 18 deg. riveted steel elbows of 15-ft. radius were inserted. At the lower ends of each line the wood-stave sections joined riveted steel lines.

The first indication of an accident to the pipe line was when gravel was shot into the turbines.

CEDAR FALLS DAM FROM WHICH WOOD-STAVE PENSTOCKS, WHICH BROKE, EXTEND TO SEATTLE'S MUNICIPAL HYDROELECTRIC PLANT

Kentucky to Spend $2,900,000 for Good Roads

The offer of the State of Kentucky to furnish financial assistance toward road improvement has stirred the several counties to an unusual degree of activity. It is expected that $1,200,000 will be spent this year under the State-aid plan and that an additional $1,700,000 will be spent by the counties themselves on individual improvements.

Bills Propose Convict Labor for Massachusetts Highways

Bills have been introduced into the Massachusetts Legislature to provide that prisoners may be employed in large numbers upon the highways of the State. Last year an amendment was passed permitting prisoners to be used by counties, cities, and towns on the roads, under the custody of the local sheriffs. The present bills seek to broaden the scope of this work and to place it under the supervision of the State Highway Commissioner, as recommended by the National Committee on Prisons and Prison Labor.

Need $13,500,000 Extra to Complete New York Barge Canal

That $13,500,000 in addition to the original appropriation of $101,000,000 will be needed to complete the New York State Barge Canal is the reported statement of Frank M. Williams, State engineer and surveyor. It was also said that if the money was made available in time the entire system could be put into service in 1917. The $4,000,000 appropriation now pending before the Legislature will be needed to complete existing contracts and will not warrant the making of any new ones.

Ohio Board of Boiler Rules Indorses American Society Code

H. V. Neff, chairman of the Ohio Board of Boiler Rules has issued a notice authorizing certified inspectors to inspect during construction, and on completion to stamp Ohio-Standard on any boiler constructed in accordance with the rules formulated by the Boiler Code Committee as submitted to the council of the American Society of Mechanical Engineers, Feb. 13.

Western Society Would Join Military Reserve

Lieut. Col. W. V. Judson, Engineer Corps U. S. Army Addresses Civilian Engineers on "Engineering in War"

Seventy engineers, members of the Western Society of Engineers, signified their willingness to take instruction, attend camp, and become a part of a civilian military engineering reserve, at a meeting held April 5. This expression of opinion was the result of a request by the officials of the War Department studying the proposition of a civilian military reserve for national defense.

The committee of the Western Society of Engineers on civilian military reserve, consisting of H. S. Baker, Dabney Maury, C. C. Saner, T. Frank Quilty, Taliferro Milton, Ernest McCullough and W. W. De Berard, learned from the War Department that as yet it was not in a position to propose a definite plan of co-operation by which civilian engineers can be enrolled in a reserve available in time of need. By direction of Secretary Garrison the general staff is now engaged in formulating recommendations for a more efficient army and an adequate reserve of men and equipment. Although the plans are still in a formative stage tentative letters have been drawn up to be sent to the engineering societies should necessary authority and funds be obtained.

The committee will be continued and will increase its membership by admitting such as may become interested in the movement. It will continue the study of military engineering by lectures and discussions so that when the time comes for the War Department to propose a definite plan the society will be in a position to co-operate immediately.

The War Department now maintains lists of reserve officers for volunteer troops. Engineers who have had military training in college or experience in the army or in the national guard may enroll themselves on the reserve list of engineer officers by passing a regular examination in military and engineering subjects in accordance with general order 54. Several members of the Western Society, including Capt. L. S. Marsh, First-Lieut. H. S. Baker, assistant city engineer of Chicago; D. A. Tomlinson, assistant engineer of the Chicago & Western Indiana Railroad, and C. C. Saner, assistant engineer, city of Chicago, are members of Company A, of the First Battalion of Engineers of the Illinois National Guard.

Lieut.-Col. W. V. Judson, of the U. S. Engineer Corps addressed the society on "Engineering in War," describing the various duties of the army engineer in service. Colonel Judson was a military attaché with the Russian army during the Russo-Japanese war and entertained the society with some extremely interesting information. His talk was illustrated by a large number of slides showing actual war scenes during the far eastern conflict as well as "good practice" in military engineering work.

About 225 men attended the meeting. The meetings for the past year have averaged well above the 200 mark.

Wisconsin Student Exposition Attracts Large Attendance

The exposition given by the students of the University of Wisconsin, which was held at Madison, March 25, drew an attendance of a thousand. An endeavor was made to make this exposition truly representative of the various aims of the university and the civil engineers were represented by exhibits that included surveying instruments, a model of a sewage disposal plant, a miniature railway, a model of a water turbine, specimens of paving materials and other equipment and construction lying within their field.

ENGINEERS' EXHIBIT AT STUDENTS' EXPOSITION

MODEL OF SEWAGE DISPOSAL PLANT

To Charge Royalty on Sand and Gravel in Great Lakes

Regulations have been adopted in Ontario, Canada, governing the leasing of sand and gravel concessions in the Great Lakes. The Minister of Lands, Forests and Mines may grant licenses for the removal of these materials, allowing each licensee one dredge or operating plant for a fee of $100. He may fix a royalty rate per cubic yard and require a plan of the area to be operated and a monthly statement of operations. His agents are to have full access to the concessions for purposes of inspection and no sand or gravel may be exported from the country without his consent.

American Waterworks Association Plans for Convention

The Hotel Gibson has been selected as the headquarters of the American Waterworks Association for its thirty-fifth annual convention, to be held in Cincinnati, Ohio, May 10-14. The transportation committee has made arrangements with the Pennsylvania Railroad for a special train from New York. This will leave 10.04 a. m., Sunday, May 9, and arrive at Cincinnati 6.30 a. m., May 10. The regular one-way fare from New York to Cincinnati is $18.68. Reservations on this train should be made with O. T. Boyd, division passenger agent, Pennsylvania Railroad, 263 Fifth Avenue, New York City.

Some papers to be read at the convention have already been received and others are promised. Thursday, May 13, has been set aside as Superintendent's Day. The question box will be taken up and general waterworks topics will be discussed.

Connecticut Board of Health Seeks Control over Stream Pollution

Broad powers in controlling the discharge of sewage into the inland and tidal waters of Connecticut are granted to the State Board of Health in a bill now before the Legislature. By the terms of the proposed act the board of health may make and enforce rules and regulations and order works to be executed to prevent the pollution of streams. An important provision vests the health board with power to compel the operation of sewerage systems and treatment works in a manner which shall protect the public health. After the passage of the act no sewerage system or auxiliary works may be built until the design has received the approval of the State Board of Health. The right of appeal to the superior court from an order of the health board is granted. The penalty for the discharge of sewage without a permit is $500 and $50 for each day the offence is maintained.

Chicago Votes $4,000,000 Bonds for Municipal Works

At its election on April 6 the City of Chicago approved bond issues for municipal work exceeding $4,000,000. As a result of the decision of the electorate $700,000 will be available for garbage plant improvements; $500,000 for the completion of a hospital; $2,000,000 for fire and police stations; $600,000 for bathing beaches and playgrounds; and $310,000 for dormitory and women's shelter house.

Illinois County Highway Men Organize

About 100 Illinois county highway superintendents met at Springfield, March 30 to April 2, in connection with the short course in highway engineering given by the State Highway Commission. An organization of county highway superintendents was effected at that time with the following officers: President, R. W. Osborn, Livingston County; vice-president, P. B. Wilson, Williamson County, and W. Emory, Peoria County, secretary-treasurer. The State was divided into seven geographical districts and a director was elected from each district as follows: P. O. Thomas, St. Clair County; G. C. Fairdo, Champaign County; Edwin White, Sangamon County; E. R. Gates, Du Page County; E. S. Mokinger, Fulton County; Alexander Anderson, Ogle County and George H. Brown, White County.

Plans for Removing Public Service Commissioners Modified

According to press reports from an apparently reliable source the evidence brought out by the recent investigation of the New York Public Service Commission for the first district is not believed by Governor Whitman to contain evidence which warrants the removal of any of the present commissioners. The same report states that the present plan is to legislate both Public Service Commissions out of existence and replace them by a single commission of seven members, with two additional members who will hold office until the completion of the dual subway system in New York City, and who will supervise that work. The present State administration would, of course, name the new commissioners, and it has been rumored that William Hayward, formerly legal adviser to the Governor, is slated for the chairmanship of the new body.

In the meantime, Mr. Hayward has been appointed by the Governor and confirmed by the State Legislature to the vacancy created by the expiration of the term of Milo R. Maltbie. The new commissioner was first assistant to Governor Whitman when the latter was District Attorney of New York. There was a lively fight over the confirmation of this appointment on the Senate floor. Republican leaders defended the appointment by saying that it was a return to the practice of selecting men for their ability, inaugurated by Governor Hughes in first forming the commission. It has been pointed out that Mr. Maltbie was one of Governor Hughes' first appointees to the Public Service Commission.

Asks Co-operation to Minimize Openings in New Pavements

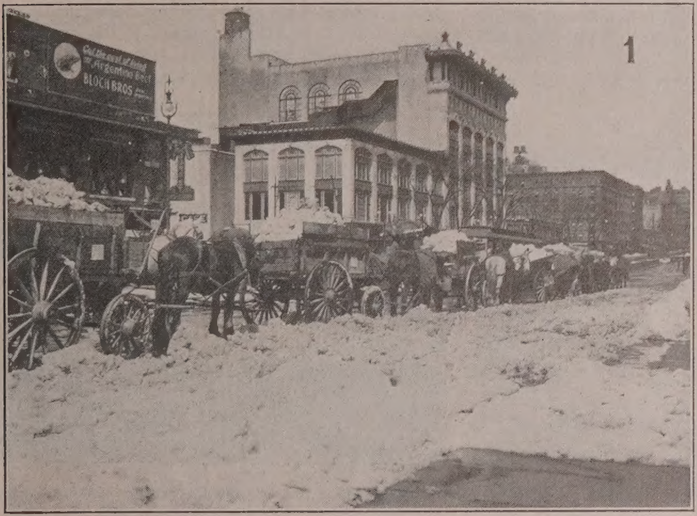
Marcus M. Marks, president of the Borough of Manhattan, New York City, will hereafter make public lists of streets which are about to be paved or repaved. This is being done in the expectation that those having, or about to install, subsurface structures, will make all repairs, alterations or installations promptly after publication of the list and, in this manner, prevent cuts in new pavements.

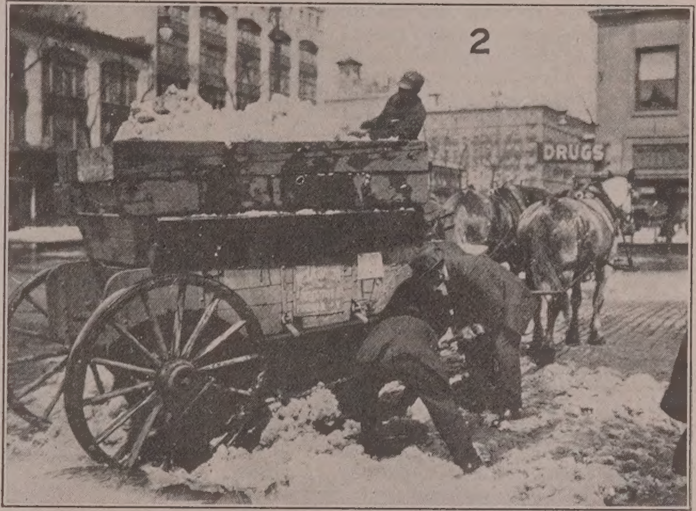
New Water Commission Appointed for California

Under the law passed by the last legislature, Governor Johnson of California on March 15 appointed a new water commission, consisting of Irving Martin, A. E. Chandler and W. A. Johnstone, which will have jurisdiction over all water rights, irrigation problems and applications to appropriate water for all purposes. It is hoped that with the powers given the new commission it will be possible to untangle conflicting water claims in the State and establish rights to better advantage than formerly.

Snow-Fighting Methods Clear New York's Streets After Record April Storm

A 10-Inch Fall Last Saturday Almost Doubled the Former Mark of 5.5 Inches Recorded by the U. S. Weather Bureau on April 9, 1907. Sewers and the Street Hydrants Were Used Effectively for Disposing of the Snow





Typical Scenes on Upper Broadway After Storm

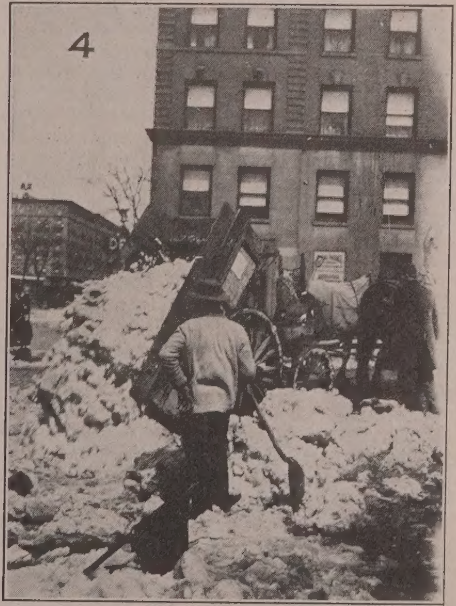
1. Teams waiting to dump at Broadway manhole.

2. Discharging load into sewer from bottom-dump wagon.

3 and 5. Clearing gutters with hydrant streams.

4. End-dump cart at manhole.

6. Two carts discharging simultaneousely.



Imperial Valley Flood Protection Inspected by Secretary Lane

Secretary Lane returned East from the Pacific Coast by way of Yuma and Phoenix, stopping off long enough to look over the government work in protecting Imperial Valley from the flood waters of the Colorado, as well as the reclamation service work on the Salt River Project. In commenting on the Imperial Valley situation Mr. Lane pointed out that the work now under the direction of Gen. W. L. Marshall, one half of which is being paid for by the Government and the other half by the water users of the valley, would insure the protection of the valley temporarily, and that beyond the immediate needs the Administration has formulated no definite policy.

He referred to the fact that for the past year engineers in the employ of the Federal Government have been engaged in a preliminary survey of the upper river, but have as yet made no report. The final and permanent solution of the problem of controlling the Colorado, he intimated, may prove to be in the construction of reservoirs in the upper reaches of the river.

Giant Blast at Quarry Required Six Months' Preparation

The face of a limestone quarry near Riverside, Cal., owned by the Riverside Portland Cement Company, was recently broken up for convenient handling in a single gigantic blast that utilized 60 tons of explosives and moved between 125,000 and 135,000 tons of rock. During the past 6 months a crew of men have been constructing, behind the face of the quarry, a T-shaped tunnel 500 ft. long in which to place the powder charges. For two weeks prior to the blast twenty men were engaged in loading eleven wells spaced at intervals along the tunnel line. The effect of the explosion, it is reported, was to shatter a section of the face of the quarry 160 ft. high and 900 ft. long, which will supply the cement plant with enough limestone to last nearly a year.

Big Demand for Space at 1916 Chicago Cement Show

It has been found necessary to secure the First Infantry Armory in addition to the Coliseum and the Annex for the Ninth Annual Cement Show to be held in Chicago in February, 1916. All the space available in the Coliseum and the Annex was assigned to the one hundred exhibitors who applied in time to participate in the drawing, which would have meant that forty exhibitors who had participated in the eighth show, as well as seventy other applicants for space, could not be accommodated. Arrangements were made, therefore, to rent the armory. The show will open Feb. 12, 1916, which a change from the date originally set, and will close Feb. 19.

Conference Discusses Route of Proposed Dixie Highway

A conference to decide upon the route of the proposed Dixie Highway between Chicago and Miami, Fla., was held at Chattanooga, April 4. Governors of a number of the southern States were present and there were large delegations from the cities through which the new road will pass.

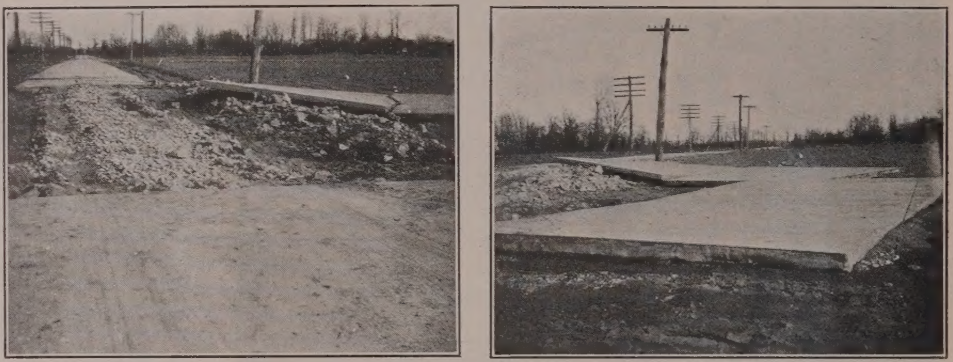
President Wilson sent to Congressman Moon, of Chattanooga, the following telegram, which was read at the conference:

"May I not through you convey my cordial congratulations upon the inauguration at Chattanooga to-day of the Dixie Highway, projected to run from Chicago to Miami? Such a highway will be of the greatest importance alike to the people of the East, the South and the Middle West, and I shall watch its progress toward completion with the greatest interest."

A plan is said to have been agreed upon for the appointment of State commissions to select the highway route.

River on the Rampage Plays with Concrete Road

Flowing at an estimated rate of 40 mi. per hour, the Ohio River recently overflowed near Evansville, Ind. Lying in the path of the turbulent waters was the Henderson road paved for 1300 ft. with a reinforced-concrete pavement, 15 ft. wide, with expansion joints every 30 ft. The accompanying photographs show how the huge slabs of concrete pavement were lifted by the raging water and carried to one side of the road. One slab was moved 30 ft. and did not disclose a crack as a result of its rough handling. Seven others were more or less tumbled about without the slightest damage and four more showed slight transverse cracks, due to the fact that when they fell to place off the roadbed they did not lie level.



HUGE 30-FOOT SLABS OF REINFORCED-CONCRETE PAVEMENT AFTER BEING SUBJECTED TO SEVERE TEST

Organize to Clean Chicago

Plans for cleaning Chicago were outlined last week at the first business meeting of the Clean Chicago Federation, a new organization which proposes to rid the air of smoke, the streets of dirt, the city of vice, in other words make Chicago as near clean as human agency can. It is the aim of the federation to enlist a membership of 200,000 to carry out its plan. With this membership any candidate for office will have to stand for decency, it is argued, if he is to be given the vote of the members.

Canada to Operate National Transcontinental Railway

The Canadian Government will at once, it is stated, begin operating the National Transcontinental Railway, which extends from Moncton, N. B., to Winnipeg, Man., a distance of 1800 mi. The Grand Trunk Pacific Railway, for which the line was built, has declined to lease or operate it, on the ground that the terminals in Quebec are not finished, and that the road is otherwise incomplete.

Water Turned into New San Diego Supply Conduit

Formal opening of a $135,000 extension of the San Diego Water Supply system took place Mar. 27 when Mayor O'Neal of that city opened the conduit intake at the mouth of Morena Gorge. The work has involved the construction of a 6½ mi. conduit along Cottonwood Creek between two dam sites in the system. The conduit has a capacity of 40,000,000 gal. per 24 hr. and was found to be necessary after the completion of other parts of the system, because of the heavy percentage of the flow lost in seepage when the water followed the natural channel.

Plan Improvements to Prevent Subway Accidents in New York

To safeguard against an accident similar to that which occurred in the New York City subway, Jan. 6, and which was described in this journal Jan. 9, the Public Service Commission of the First District, New York, has directed its counsel to prepare an order to the Interborough Rapid Transit Company embracing the following requirements: A separate and complete telephone system to be installed with telephone stations at frequent intervals along the roadway between stations; an improved lighting system to be installed throughout the subway, so arranged that, in case of failure of one source of supply, another will automatically take its place; to install an additional, independent source of power supply for operating the ventilating fans; power, signal and light cables to be rearranged in manholes so as to guard against a breakdown in one class of cables being communicated to another; ventilating outlets for existing subway manholes to be installed where required and additional ladders and stairways from the subway to the street through existing ventilating chambers to be installed for use as emergency exits.

Toronto Good Roads Convention Attracts Attendance of 2000

Two thousand delegates from the United States and the Dominion of Canada were present at the Canadian and International Good Roads Association Convention at Toronto, Ont., March 23.

"It Pays to Advertise"

Among replies to its advertisements the Pelton Water Wheel Company, of San Francisco, has received the following remarkable letter:

Pelton Wheel & Electrical Co.,
San Francisco, Calif.

Dear Sirs:

Mr. Pelton I have discovered a new force, the sculler of physical force never would dream of.

Wheel six feet in diameter, one hundred pound power with unlimited speed. Would that give force enough to supply several hundred burners for electric light?

I fully understand the velocity when you increase your speed you loose your force.

Yours truly,

Officials and Engineers Indorse Illinois Waterway Bill

A public discussion of the Illinois deep waterway bill which calls for the immediate improvement of the waterways of the State by constructing an 8-ft. channel, using the Illinois and Michigan canal and the Illinois River, was held at Springfield, March 24. This bill is advocated by Governor Dunne and was indorsed at the meeting by the following speakers: Attorney General Lucey; United States Senator Lewis; Lyman E. Cooley, consulting engineer of the Chicago Sanitary District; E. J. Kelly, assistant chief engineer of the Chicago Sanitary District; and Leroy K. Sherman, member of the Rivers and Lakes Commission.

Pumps Begin to Unwater Huge Cofferdam for 1000-Foot Pier

Unwatering the cofferdam for the shore end of the new Forty-sixth Street pier, New York City, was begun on March 29. This structure, which was described in the Engineering Record of July 18, 1914, page 68, is one of the deepest large unbraced cofferdams ever constructed. It is roughly 800 x 250 ft. in plan, and will be pumped to an elevation 44 ft. below mean low tide. One No. 10 centrifugal pump of 2500 gal. capacity had taken the water down about 7 ft. below low tide on April 6. Pumping is proceeding slowly, this pump being run only sixteen hours a day, in order that the behavior of the cofferdam may be closely watched. The steel sheeting is driven to rock at all points, and the rock is overlaid with stiff blue clay. Excellent material was found for filling the cofferdam, and the maximum leakage so far observed is only about 600 gal. per minute.

A raft 36 ft. square containing three solid courses of timber is being built to float the second-stage pumps. Two 1000-gal., and one 450-gal. electrically driven pumps will be mounted on this raft to complete the unwatering. The pump now being used is mounted on stone banking inside the river arm of the coffer. This is supplied with steam from a floating driver tied up along the cofferdam. Unwatering will probably be finished and work begun in the cofferdam in a month.

Adopt Society of Mechanical Engineers Boilers Specifications

Boiler specifications prepared by the American Society of Mechanical Engineers, assisted by a joint committee of the American Boiler Manufacturers' Association and the National Tubular Boiler Association were reported on and unanimously adopted at a meeting in Pittsburgh March 29. Ways and means were discussed for promoting them and inducing the various States to adopt them.

Lake Keechelus Dam Breaks

The Government dam impounding the waters of Lake Keechelus, just east of the summit of the Cascade Mountains in Washington, broke March 26. The water goes into the Yakima River and flows past the towns of Easton, Ellensburg, North Yakima and smaller communities along the Yakima Valley. The river was able to hold the water that poured into it and the Chicago, Milwaukee & St. Paul Railway, which would be the heaviest sufferer by a flood of the upper Yakima River, says the situation is not alarming—that not even wagon bridges will be lost. The dam has been in service a number of years.

Miraflores Purification Plant in Service at Panama

The new filtration plant at Miraflores, in the Canal Zone, the largest and most complete purification plant in Central America, was placed in service on Sunday, March 14. All water supplied to the Canal villages south of Paraiso and the city of Panama, according to the "Canal Record," is now purified at this plant after being pumped from the Chagres River at Gamboa. The water passes first through a process of aeration, followed by coagulation, sedimentation and filtration, after which it is treated with hypochloride of lime.

Georgia Plans Conference on Sanitary Engineering

In an effort to create throughout Georgia an appreciation of the importance of sound doctrines concerning water supply and sewerage a State conference, to be held at the University of Georgia, in Athens, on April 19 and 20 has been arranged by Prof. C. M. Strahan. This is a new form of university extension effort to which the Georgia institution is already committed in agriculture and road-building. Among those who will deliver addresses are Leo Hudson, consulting engineer, of Pittsburgh; Leonard Metcalf, of the firm of Metcalf & Eddy, Boston; C. C. Hommon and P. H. Norcross, of Atlanta; and Roy C. Werner, analyst of the State Board of Health.

Chicago Engineers Discuss Their Commercial Welfare

Relations to the engineering profession of commercial and financial organizations and of the opportunities for mutual service were discussed at a recent meeting of engineers who are members of the Chicago Association of Commerce. It was suggested that the Association would materially promote the interests of its engineering members by having on file at headquarters information relating to qualifications for certain classes of work, and being prepared to advise inquirers accordingly, and thus bring the members of the profession in Chicago more prominently before the public of the United States and Canada.

It was also noted that while the engineers in Chicago maintain societies and clubs of a professional nature and those for social purposes, there is no organization in Chicago for the express purpose of promoting the commercial welfare of engineers. It was contended that this service might be performed by the association while subserving the interests of manufacturers, distributors and professional people other than engineers.

While discussing the merited honors conferred upon Colonel George W. Goethals and Colonel William C. Gorgas, attention was called to the splendid service given by the late Colonel David DuB. Gaillard, and the suggestion was made that recognition should be given to him and his family for the sacrifices endured while engaged in the great work at Panama. Resolutions will be submitted to the President of the United States, and members of Congress, as a memorial to him.

Week of Celebration to Commemorate Canal Opening

To fittingly commemorate the opening of the Dalles-Celilo Canal, which removes the last barrier to the free navigation of the Columbia River and its tributaries, from the Pacific Ocean for 500 miles inland, a series of celebrations, extending from Lewiston, Idaho, to Astoria, Oregon, will be held during the week of May 3-8, 1915.

Install Liquid Chlorine Plant at Sacramento Intake

A liquid chlorine plant was put in operation on March 4 at the intake of the city water supply for Sacramento, Cal., and, pending readjustment of the dose when culture tests have been made, the initial rate of charging was one part of chlorine per 4,000,000 parts of water. The charging plant consists of three units housed in corrugated iron sheds and placed over the intake in the Sacramento river. The equipment was supplied by the Electro Bleaching Gas Company, of New York.

The purification plant is a temporary expedient and is provided for immediate relief from the high typhoid bacteria content of the river water. G. H. Wilhelm and Prof. Charles G. Hyde are preparing plans for new city water-supply and sewage-disposal systems, and it is expected that permanent changes will be made as soon as feasible. Advance reports of the investigations being made by these two engineers are to the effect that a single distributing system will be recommended for Sacramento instead of separate systems for domestic and high-pressure uses, as first suggested. It is now proposed to increase the pressure in the business section from 45 to 75 or 80 lb. per sq. in., and from 60 to 65 lb. per sq. in. in the residence district.

News of Engineering Societies

The Engineers' Club of Trenton has rented rooms in the Trent Building for a headquarters of the club.

The Southwestern Waterworks Association will hold its annual convention at Galveston, Texas, June 14-16.

The National Fire Protection Association will hold its annual meeting at the Hotel Astor, New York City, May 11-13.

The Rochester Engineering Society heard E. J. Mehren, editor of the Engineering Record, speak on "The Making of a Technical Journal" at a meeting held in that city April 9.

The Associated Engineering Societies of St. Louis held a joint meeting in that city April 7. Edward E. Wall, water commissioner of the city, spoke on "The Future Water Supply of St. Louis."

The Canadian Society of Civil Engineers heard a paper on "Edmonton's Tunnel Sewerage System," by A. J. Latornell, read by Prof. E. Brown at a meeting held in Montreal April 8. The subject was illustrated by lantern slides.

The Brooklyn Engineers' Club heard a paper by M. H. Freeman and J. F. Sanborn on "Grouting the Shafts, Tunnels and Other Structures of the Catskill Water Supply System" at a meeting held in that borough of New York City April 8.

The Engineers' Section, Chicago Association of Commerce, will be addressed April 23 by C. E. Drayer, of the New York, Chicago & St. Louis Railroad Company and chairman of the publicity committee of the Cleveland Engineers' Club. His subject will be "Engineering Publicity."

The Colorado Association of members of the American Society of Civil Engineers will hold a meeting in Denver April 10, which will be preceded in the afternoon by a visit to the Colfax-Larimer Viaduct, now in the course of construction. H. S. Crocker, consulting engineer in charge of the work, and his assistants will act as hosts. Charles V. Eades, of the Standard Asphalt & Rubber Company, Chicago, will address the evening gathering on "Waterproofing and Insulation."

The Efficiency Society of America was incorporated at Columbus, Ohio, April 2, by G. E. Burroughs, L. B. Passmore, Grover Schaible, Anthony Golubich and H. B. Hatch, of Cleveland and Pittsburgh, in behalf of a charter membership association of some 1500 technical and commercial men resident in Canada, the United States, Mexico and South America. The objects for which the society has been formed are to promote questions relating to administrative, productive and commercial efficiency; to promote questions relating to domestic and foreign trade, with especial reference to trade expansion and engineering construction opportunities for the individual, professional, technical and business man, and to maintain a free information and statistical exchange for the use of the members. The society will publish a monthly and weekly journal, first issue to appear May 1.

Personal Notes

Homer Hamlin, city engineer of Los Angeles, Cal., has resigned.

John J. Collins has been appointed commissioner of street cleaning of the Borough of Richmond, New York City.

Spire Pitou, Jr., has succeeded Lewis Nixon as commissioner of public works of the Borough of Richmond, New York City.

H. C. Kittredge, of Rochester, N. Y., has been engaged as consulting engineer on the new waterworks system of Oakfield, N. Y.

Edward M. Bigelow has resigned from the office of highway commissioner of the State of Pennsylvania. He was appointed to this office in 1911.

E. A. Bonney has assumed the office of consulting engineer of the New York State highway department, succeeding George A. Ricker, resigned.

W. H. Boeh has been appointed county surveyor of Hamilton County, Ohio. He succeeds Clinton Cowen, recently appointed State highway commissioner.

Samuel D. Foster has resigned from the office of chief engineer of the Pennsylvania State Highway Department. He was appointed to that office in June, 1911.

S. Wiley Wakeman, until recently with the New York Shipbuilding Company, Camden, N. J., is now general superintendent of the Fore River Shipbuilding Company, Quincy, Mass.

Hurlbut S. Jacoby, formerly chief engineer of the Standard Steel Construction Company at Welland, Ont., has been appointed instructor in civil engineering at Pennsylvania State College.

W. A. Calhoun, consulting engineer of the Southwestern Kentucky Electric Railway, Light & Power Company, has been appointed a member of the park commission of Paducah, Ky.

H. M. Sharp has been appointed construction deputy by Clinton Cowen, the newly appointed commissioner of State highways of Ohio. Mr. Sharp was formerly connected with the Kelly Construction Company of Bryan, Ohio.

F. D. Huntington has been elected vice-president of the John W. Cowper Company, engineers and contractors, of Buffalo, N. Y. Mr. Huntington was formerly connected with the English contract department of the J. G. White Companies, and more recently with the Brazil Railways.

Alexander Robertson, assistant to the president of the Missouri Pacific Railway, has been appointed to the position of chief operating official. E. J. Pearson, whose appointment to the first vice-presidency of another line is announced elsewhere in these columns, formerly had charge of this department.

J. G. White & Company, of New York, have been retained as consulting engineers by the Public Service Commission of the First District, New York, to work with the engineering department of the commission in perfecting some new system of ventilation for the subways now under construction in New York City.

Clifford B. Moore has been appointed consulting engineer of the Borough of Queens, New York City, succeeding Foster Crowell, whose death was announced in this journal April 3. Mr. Moore was in charge of the borough topographical bureau previous to this appointment, and before that was connected with the Croton Aqueduct Commission of New York City.

T. J. Wyche, chief engineer of the Western Pacific Railroad, has been appointed assistant general manager, with headquarters at San Francisco. Mr. Wyche was appointed to the position of chief engineer in 1910. Previous to that he was construction engineer on the Union Pacific and had charge of railroad construction costing several million dollars.

H. L. Bowlby, State highway engineer of Oregon, has resigned, but will be retained by the State to continue in charge of the work in Hood River County. He will also have charge of the settlement of all disputes for work done under his direction in Columbia, Clatsop and Jackson Counties. He was appointed to the office of State highway engineer in June, 1913.

John E. Bowe, formerly commissioner of street cleaning of the Borough of Richmond, New York City, has been appointed assistant commissioner of public works of that borough. Mr. Bowe was deputy commissioner of the Department of Water Supply, Gas and Electricity of the city of New York, in charge of the Richmond Borough office previous to his appointment as street-cleaning commissioner.

E. I. Cantine has succeeded H. L. Bowlby as State highway engineer of Oregon. Mr. Cantine, previous to this appointment, was engaged in an engineering and contracting business in Portland, Ore. He has practised as an engineer since 1887, having been graduated in that year from the University of Illinois. A great part of his work has been in connection with the location, design and construction of railroads.

Mahlon Averill and Howard B. Matthews have become associated under the firm name of the Averill-Matthews Company, for the purpose of doing a general contracting business, with offices in the Essex building, Newark, N. J. Mr. Averill, who is president and general manager of the company, has been associated with John W. Heller, a contractor of Newark. Mr. Matthews, who is secretary and treasurer, was once an assistant engineer in the U. S. Reclamation Service and has recently been connected with the work of the Pearson Engineering Corporation in Spain.

H. A. Bayfield, who was for four years superintendent of dredges for the Department of Public Works of Canada, in British Columbia waters, has been appointed principal assistant engineer of the harbor development work being carried on by the Department of Railways and Canals at Port Nelson. He is now in Ottawa, superintending the design and construction of additional equipment for this development. When this is completed he will take up headquarters at Port Nelson, where his work will consist of looking after the several dredges and other mechanical equipment in use on the project.

John W. Cowper has resigned from the office of vice-president of the Lackawanna Bridge Company of Buffalo, to become president of the recently incorporated John W. Cowper Company, which will engage in a general engineering and contracting business, with offices at the Fidelity Building, Buffalo, N. Y. Mr. Cowper has practised as an engineer since 1888, and has done considerable work in connection with railroad construction and steel erection. In 1894 he was engineer for James Stewart & Company, engaged on the erection of the buildings for the plant of the British Westinghouse Electric & Manufacturing Company in Manchester, England.

William D. Uhler, formerly principal assistant engineer of the Bureau of Highways of the city of Philadelphia, has been appointed chief engineer of the State highway department of Pennsylvania, succeeding S. D. Foster. Mr. Uhler started in engineering work in 1890 in the service of the Lehigh Valley Railroad. From that time until 1904 his activities were principally confined to railroad work. During that year he was appointed roads engineer of Carolina County, Md., in which office he remained until 1908, when he was appointed second assistant to the chief engineer of the Maryland State Road Commission. He was appointed to his office in the Philadelphia highway bureau in 1912.

Edward J. Pearson has been elected first vice-president of the Texas & Pacific Railway, with headquarters at New Orleans. Mr. Pearson was graduated from Cornell University in 1883 and entered the service of the Northern Pacific as an assistant engineer on construction work. In 1885 he became supervisor of bridges, buildings and water supplies on the Minnesota division of the same railroad, in which capacity he served for a period of five years. He attained the grade of principal assistant engineer on the Chicago & Northern Pacific and Wisconsin Central lines in 1892, and in 1894 joined the operating department as superintendent of the Missouri & Yellowstone division. He became chief engineer of the Northern Pacific in 1904 and in 1911 was elected first vice-president of the Missouri Pacific.

Obituary Notes

William Hunter, chief engineer of the Philadelphia & Reading Railway, died in Philadelphia, April 3. He entered the railway service in 1872 as a chainman in the employ of the company of which he subsequently became chief engineer. In 1876 he engaged for a brief period in mining work, and in 1877 as a level man, and later as division engineer on the location and construction of the Pittsburgh & Lake Erie Railroad. He returned to the Philadelphia & Reading in 1878 and remained in its service continuously until, in 1900, he attained the grade of chief engineer.

Francis Hopkinson Smith, engineer, author and artist, died April 7, in his seventy-seventh year, at his home in New York City. Although Mr. Smith was best known in later years for his literary efforts, his first book did not appear until after his forty-fifth year, at which time he had already accomplished much in engineering work. His early activities were confined chiefly to the construction under contract with the Government of seawalls, breakwaters and other works around New York harbor and Long Island Sound. Among other structures he built the Race Rock lighthouse and the foundations for other lighthouses, the Governor's Island seawall, breakwaters at Bridgeport, Stonington, Port Jefferson and Block Island, and the jetties at the mouth of the Connecticut River. He also built the waterworks systems at Mount Vernon, N. Y., and at Fishkill and Matteawan (now Beacon). He was elected an associate of the American Society of Civil Engineers in 1892. His best known book dealing with engineering work is "Caleb West, Master Diver," which tells of the construction of a lighthouse.

Civil Service Examination

Examinations Previously Announced

Date		See Eng. Record
April 14	Civil engineer and draftsman, ship draftsman, Navy Department; mechanical draftsman, topographic draftsman, Panama Canal service; engineer, Indian service, United States	Feb. 6
April 28–29	Surveyor-draftsman, U. S. Government service; salary $1200-$1500	Mar. 20
May 1	Utilities Investigator, State of Illinois; salary $100 to $150 per month	April 3

Business Notes

Douglas F. Stevens, superintendent of the Acme Brick Company, Cayuga, Ind., has been elected vice-president of the Illinois Clay Manufacturers' Association.

The Chesapeake Iron Works, of Baltimore, and the Lauer & Harper Company, of Westport, Md., have consolidated and will be known hereafter under the name of the former concern. The enlarged company will devote itself principally to the design, manufacturing and erection of steel structures of all kinds.

J. P. Rapp, steel wheel specialist, has resigned from the Forged Steel Wheel and allied companies and has been appointed vice-president of the Gulick-Henderson Company, of Pittsburgh, Pa. Mr. Rapp assisted C. T. Shoen in developing his car wheel and has been connected with the industry since its inception.